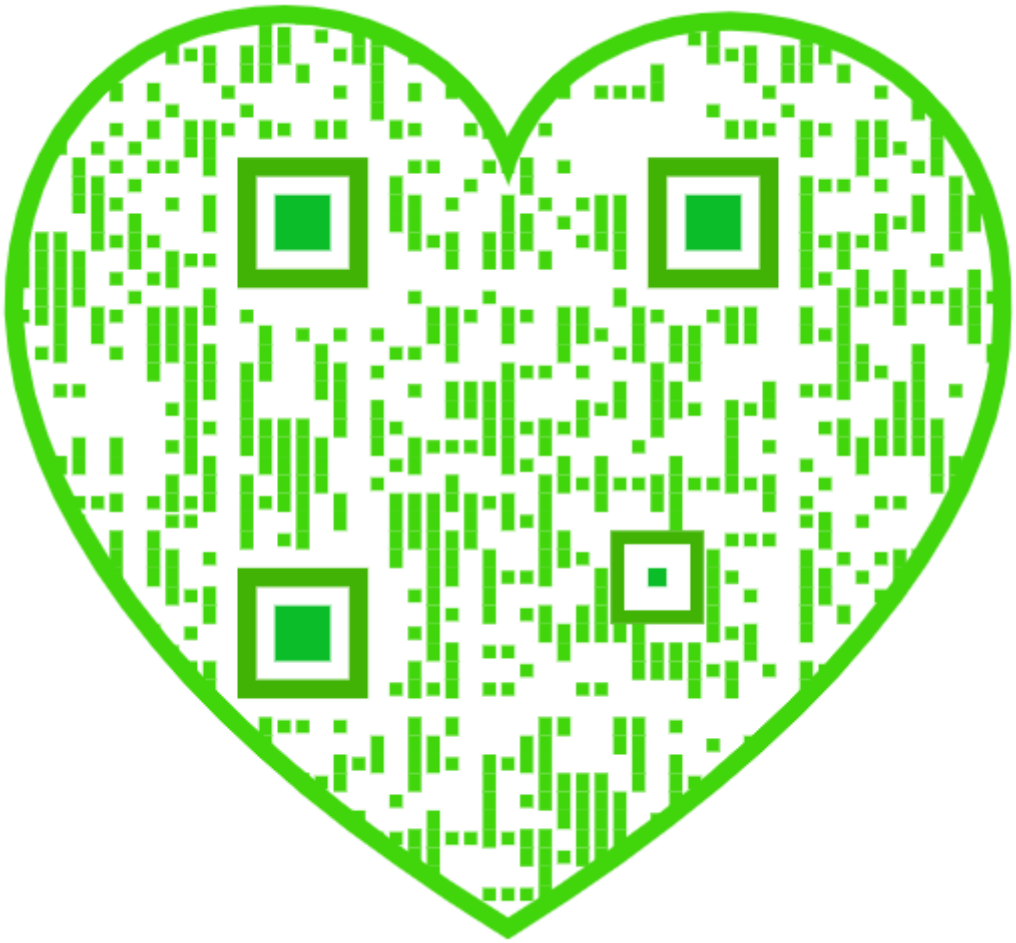

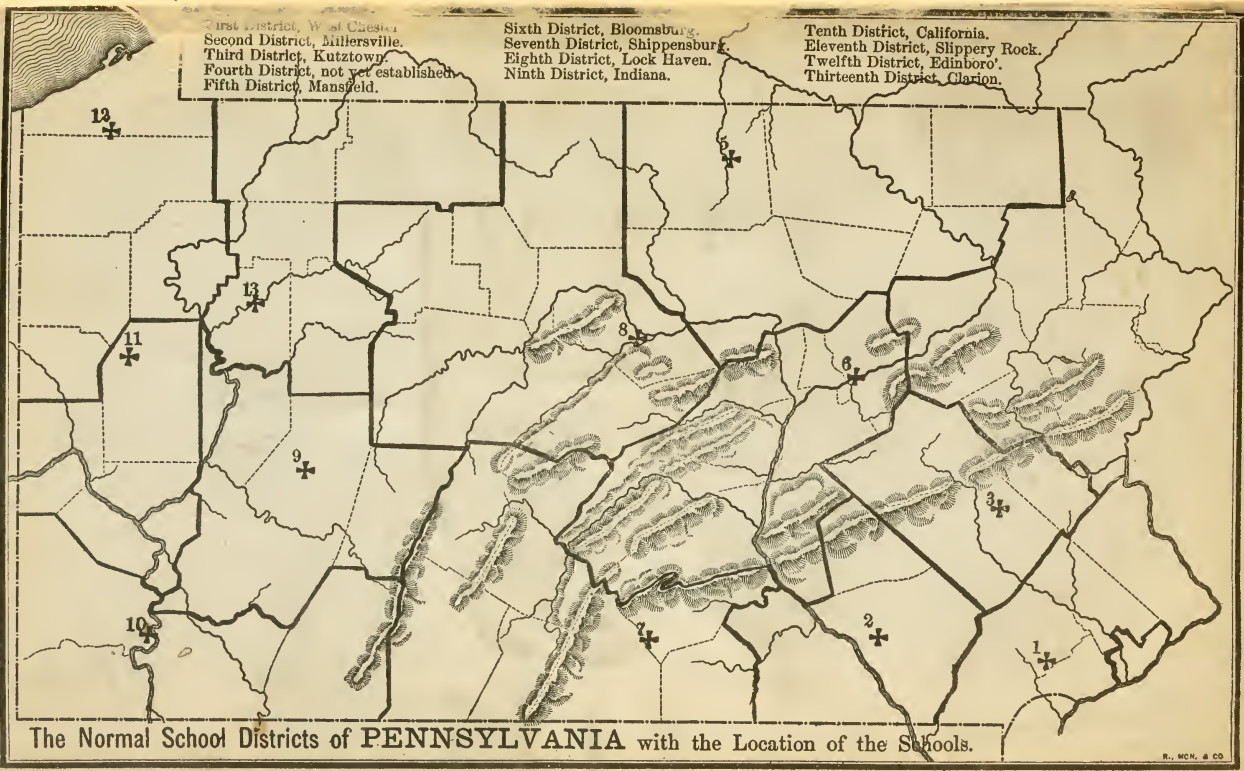

The Normal School Districts of **PENNSYLVANIA** with the Location of the Schools.

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The Geography of Pennsylvania

PHYSICAL AND DESCRIPTIVE

BY

JACQUES W. REDWAY

1895 U

SYRACUSE N Y
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1891

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Note by the Publisher.—As the author's engagements made it impracticable for him to read the proof under conditions which our printing-office could grant, this volume has been printed without his supervision, and the Index was made without his oversight. The Maps are also a subsequent suggestion and no part of his original plan. But the proof has been carefully read by Miss Speakman, teacher of geography in the West Chester State Normal School, and revised by Principal Philips of the same school. No essential changes have been made in the text except the correction of manifest errors.

PREFACE.

The usefulness of this manual depends on the judgment of the teacher. It is a manual of geography and not of 'improved methods' of teaching. Only the essential features of the geography of the State are here printed. Many of the questions following the various chapters are left unanswered in the text. Whether or not the information to which they allude is sought out depends upon the interest which teacher and pupil take in the subject.

The statistics of the State will not be published until after the census returns of 1890 have been made.

J. W. R.

PHILADELPHIA, *Sept. 1, 1889.*

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PART I.

DESCRIPTIVE GEOGRAPHY OF PENNSYLVANIA.

I.

POSITION, AREA, AND GENERAL FEATURES.

Pennsylvania is the second in size of the Middle Atlantic States. It lies mainly between New York, New Jersey, Maryland and Ohio, but it is also bordered by West Virginia and Delaware. The north-western part reaches the shores of Lake Erie; the south-eastern is washed by the tides of Delaware Bay.

The northern boundary varies from 750 feet north to 350 feet south of the 42d parallel. The boundary separating the State from Delaware is an arc of a circle twelve miles distant from the court house at New Castle. This arc leaves a small angular strip extending into Maryland known as the 'Maryland Triangle.' The famous Mason and Dixon's Line, lat. 39° 43′ N., is the southern boundary, and the meridian of 80° 32′ W., the western.

The area of the State, including 230 miles of navigable waters, is 45,015 square miles. Its greatest length is 302 miles, and its maximum breadth 177 miles. It is

about one-sixth the size of Texas, and forty times as large as Rhode Island. There are twenty-nine larger and fifteen smaller States in the Union.

The cession of certain lands by New York to the United States left a small triangular strip enclosed by New York, the 42d parallel, and Lake Erie, in the possession of the United States. This strip, known as the Triangle, was purchased by the State in 1792.

The surface of the State is greatly diversified, being a succession of mountains, valleys, plateaus and cañons. The greater part of the State is situated in the Atlantic slope and Mississippi Valley, but a small area in the northern part lies in the the basin of the St. Lawrence.

The south-eastern district is the open country lying between the Blue Mountains and the sea. This triangular section is an expanse of rolling lands, in no place more than 700 feet above the sea level. It is a fertile region of cultivated farms, inhabited by nearly two million people.

The middle belt includes the country traversed by the Appalachian Mountain System. This region is a succession of mountain ranges and table-lands, valleys and cañons. This highland region is the principal iron- and anthracite coal-producing region on the Western Continent.

The western section consists of a plateau having an average elevation of 700 to 900 feet above the sea-level and lies to the west and north-west of the Alleghany Mountains. This region produces most of the bituminous coal and four-fifths of the petroleum mined in the United States.

QUESTIONS.

TO THE TEACHER.—No attempt has been made to confine the following questions to the matter contained in the text. On the contrary, many of the answers must be sought from other sources by both teacher and pupil. The object is to inculcate original thought. Never mind if you occasionally make an error. The boy who never tumbles or falls will never become a good wrestler, runner or skater. Better err a hundred times than not to think at all. The pupil who fears to hazard an opinion for fear of making a blunder, will go through life a parasitic weakling. Discuss every point thoroughly and endeavor so far as possible to fortify every statement with evidence. Do not necessarily accept a statement because you find it made in a text-book, but consult official reports and specific works on the subject. The recitation is the place where these questions should be discussed. Do not permit anything to be recited verbatim. Use the book in the recitation. Commend every answer that shows original thought whether correct or not. All the leading text-books of geography have good special maps of Pennsylvania. The railway and transportation lines in Appleton's are the most complete and accurately plotted.

What States border Pennsylvania? Which of these is larger? Which are smaller?

What State or States north? east? south? west?

What is the extent of the lake coast?

Prove it by using the scale of miles.

Is the northern boundary between Delaware River and the Triangle a parallel of latitude? Why?

What historical reason for calling the boundary between Pennsylvania and Delaware an arc of a circle?

In what State is New Castle?

Who were Mason and Dixon?

Does any part of the State extend further south than Mason and Dixon's line?

Which is nearest the northern boundary of the State, the equator or the north pole?

Make a list of ten States larger and ten smaller than Pennsylvania.

Which of the territories is smaller than Pennsylvania?

What and where is the Triangle?

Why was it purchased by the State?

If the 42d parallel were continued to the shores of Lake Erie, how much lake coast would the State have?

What is the greatest length of the State north and south?

What is its greatest breadth east and west?

In what river basins does the State chiefly lie?

What part of the State is included in the eastern section? in the middle or highland belt? in the western section?

Which of these regions is the highest?

Which contains the greatest population?

What is the chief industry of each?

II.

MOUNTAINS AND VALLEYS.

The ranges of the Appalachian System cross the State from north-east to south-west. Of various ranges which compose this system the Blue and the Alleghany ranges are the most massive, and characteristic. None of the ranges or folds are continuous, nor is the number of ridges uniform. A range extends a distance of perhaps 50 or 100 miles and then disappears. A few miles beyond another ridge takes its place, rising perhaps in line with the former though possibly to the right or to the left.

South Mountain, which in Pennsylvania is a low outlying rise of land, extends north-eastward into the New England States, where it is known as the Green and the Taghanic Mountains. In Virginia it is known as the Blue Ridge and in North Carolina as Smoky Mountains. Here its elevation increases until the highest peaks reach an altitude of over 6,000 feet.

The intermediate ranges between the Blue and the Alleghany Mountains are marked by a singular uniformity in height. Their crests vary but little from an average elevation of 1,500 feet. Many of these ridges, especially the Pocono Mountains, are flat-topped tablelands rather than typical mountain ranges.

The highest land within the State is probably along the crest of Great Savage Mountain, an outlying ridge of the Alleghany Mountains. A surveyed summit on

Negro Mountain has an altitude of 2,826 feet; another on Keyser Ridge, an elevation of 2,843 feet. It is probable that the highest crests reach an elevation of 3,500 feet or more.

The valleys lying between the mountain ranges are usually classified as the 'rich valleys' and the 'poor valleys.' The former are comparatively level basins enclosed by high mountain barriers. They are underlaid by limestone foundations, and are remarkable for their fertility. Nittany and Kishicoquilis, among the largest of these valleys, have an aggregate area of nearly 1,000 square miles.

Great Valley, lying between South Mountain and the Blue Mountains, traverses the State from east to south. This valley, formed by the foldings of the Appalachian mountain system, extends from Canada almost to the alluvial lands of the Gulf Coast, a distance of nearly one thousand miles. It embraces a region that for productiveness is not surpassed by any other part of the Atlantic slope. Wyoming, Bald Eagle, Schuylkill, Cumberland, Pequea Valleys, are also highly productive regions. They are noted for their picturesque scenery.

Besides the valleys which lie between the numerous mountain folds, there are several which cross them. These are known as 'water-gaps' and 'wind-gaps.' In every case they are deep ravines which have been cut through the range during its upheaval, by the streams which flow in them. There are five such gaps in the Blue Mountains, where the Delaware, Schuylkill, Lehigh, Swatara, and Susquehanna rivers have pierced the range. The wind-gaps, of which there are many, are the aban-

doned channels of streams which formerly flowed in them.

QUESTIONS.

To the Teacher.—In the preparation of this lesson have the pupils read the chapter on Mountains in the second part of this manual. In connection therewith, a moulding-board exercise on mountain-formation will be of excellent service. Do not begin the moulding exercise by a description of an isolated hill or mountain: the mountain *range* is the unit. Do not teach the pupils that a mountain range consists of a number of peaks in lines. In the light of modern science such teaching is ridiculous. The essential feature of a mountain range is that it is a fold or wrinkle in the earth's crust, much worn by the action of water.

What is a mountain range? A mountain system?

Can you explain how mountain ranges came to be formed?

Does the wrinkled hand of an aged person, or a shriveled apple illustrate this?

Do you think mountains were formed in a very short time, or that their upheaval required a great length of time?

Can you explain how the Delaware and other rivers have been able to flow across one or more mountain-ranges?

In what direction do the ranges of the Appalachian system cross the State?

In what part of the United States is this system?

Does it extend beyond the United States?

By what names are parts of this system known in New York?

In what part of Pennsylvania is South Mountain?

Is it a lofty or a low range in Pennsylvania?

What large towns at or near the place where South Mountain is traversed by the Delaware River?

By what name is this mountain known in Virginia? in North Carolina? in the New England States?

Name some of the principal ranges of the system in Pennsylvania?

In what part of the State are the highest ranges of this system?

What is a table-land? *Ans.*—A *table-land* is commonly a flat-topped mountain, while a *plateau* is any continuous highland of considerable extent. The table-land is more properly called a *mesa* (pro. mā'sä).

What is a valley?

Do valleys lie between mountain ranges or across them?
What is the difference between a valley and a pass?
What is said of the 'rich' valleys of the State?
Name some of the most important valleys near you.
Where is Great Valley?
Does it extend beyond Pennsylvania?
What are 'water-gaps' and 'wind-gaps'?
Can you explain how they were formed?

III.

DRAINAGE.

The surface of the State is drained practically by three rivers and their branches, the Delaware, the Susquehanna and the Ohio. A small part of the middle belt lies in the watershed of the Genesee River, and most of the Triangle is situated in the slope of Lake Erie. These portions, covering only a few square miles in area, belong to the basin of the St. Lawrence.

Delaware River has its main sources in New York, among the Kaatskill Mountains. Flowing in a southerly course it breaks through the Blue or Kitattinny Mountains at the famous water-gap near Stroudsburg, Monroe Co. From this point to Trenton, New Jersey, the river is a series of shallows and rapids. At Trenton is the highest tide-water, and to this point light-draught steamboats ascend with the flooding of the tide. Large ocean steamers find a safe depth of water as far as Philadelphia, and below this city the river widens out into the broad estuary known as Delaware Bay. The most important tributaries in Pennsylvania are the Schuylkill and Lehigh Rivers, neither of which is navigable—except by the canals which border it.

The Susquehanna, which with its branches drains the middle region, is one of the longest rivers of the Atlantic slope of the United States. The North Branch rises in the foot-hills of the Kaatskill Mountains in New York, the main source being in Otsego Lake. The

West Branch has its sources west of the Alleghany Mountains, only a few miles distant from those of the Alleghany River.

At Sunbury, Northumberland county, the two branches unite, and pierce successively the ranges of the Appalachian System. Flowing in a wide but shallow channel the river finally enters Chesapeake Bay.

No part of the Susquehanna is navigable for vessels, but there is probably no other river south of Maine upon whose waters half so much lumber is rafted. The mouth of the river is apt to be clogged with ice at the breaking up of winter, and there is no other river in the United States in which the ice-gorge is so heavy and destructive. The Juniata, Swatara, Raystown, Lackawanna, and Pine are among the most important branches in Pennsylvania.

The Ohio and tributaries drain the western part of the State. This river is formed by the junction of the Alleghany and the Monongahela Rivers. The former is navigable a distance of about sixty miles, while the dams across the latter have given it slack-water navigation for a considerably greater distance.

The principal tributaries of the Alleghany are Kiskiminitas, Red Bank, Clarion and French Creeks: the Youghiogheny (yŏk′hō gā nī′) is the only important branch of the Monongahela. From the confluence of these rivers there is nearly 20,000 miles of navigation, opening up direct commercial intercourse with more than thirty millions of people.

Lakes.—Pennsylvania lies mainly south of the lake-belt, and therefore is almost destitute of lakes or ponds. Excepting Lake Erie, the existing lakes are insignifi-

cant in size and few in number. All of them lie north of the moraine or low walls of gravel that were pushed into the northern part of the State during the glacial epoch. They are most numerous in Pike, Wayne, and Crawford counties.

Lake Erie, the fourth in size of the Great Lakes, covers an area of 7,800 square miles. Its surface-level is 573 feet above that of the sea. Its depth is only 120 feet, and it is probably the shallowest lake of considerable size in the world.

QUESTIONS.

To the Teacher.—In teaching the hydrography of rivers and running water an out-of-door exercise on a rainy day is advisable. The rills which trickle along the road will show on a small scale all the phenomena that such rivers as the Colorado and the Mississippi show on a grand scale. Lead the pupils to discover that in one part of its course the stream is erosive; in another part sediment-bearing; in another that it is building a plain. Have each pupil draw a light pencil line on the map that shall separate the various river-basins or water-sheds of the State. This line is a rim or ridge called a 'divide'—not a water-shed. Do not call it a 'water-parting.' Impress the fact that the divide may not always correspond with the crest of a mountain-range—the Delaware and Susquehanna rivers will show this. Lakes and lake-basins can be conveniently studied on the moulding-board. Impress the fact that lakes are often ephemeral features of a river,—silted up by the stream which flows into it and reduced in size by the outlet which constantly cuts its rim lower. Read also the chapters on Rivers, Lakes, and Glaciers.

What is a river?

What is the source of a river? the mouth?

Has a river ever more than one source?

Has a river ever more than one mouth?

What is a delta?

Can you explain how the delta is formed?

Where does the 'mud' or silt sometimes in the water of a flowing stream come from? What becomes of it?

Can you explain why a river or creek will wear deep gulches in one place, and spread silt over the land in another?

When is a river most apt to be muddy?

Does a stream whose waters are always clear wear away its bed rapidly?

Draw light pencil lines which shall separate the Susquehanna and its tributaries from the Ohio and its branches. From the Delaware River and its branches. These lines are called *divides*, and they separate the various water-sheds or river-basins of the State.

Is any part of the State drained by streams which flow into Lake Erie? by rivers which flow into Lake Ontario?

Name the principal branches of Delaware River. Of Susquehanna River. Of Ohio River.

Which is the longer, Delaware River or Susquehanna Riv

Which has the greater water-shed?

Do any parts of these watersheds lie outside the State?

Where does the Delaware River rise? Susquehanna River? What streams form the Ohio? In what direction does each tributary flow?

In what part of the State are there a number of small lakes or ponds?

Are any of them salt? Why?

Can you tell how salt lakes are formed?

Are all lakes without outlet salt?

How would a vessel go from Erie to Philadelphia?

Which has the greater number of lakes, Pennsylvania or New York?

VI.

THE SOIL AND ITS PRODUCTS.—CLIMATE.

Soil.—There are many varieties of soil in the State, but the most fertile are those of the valleys, and of the limestone region in the south-east. The limestone, or rich valleys are especially productive. The mountain slopes of the middle belt are generally uncultivated, not because the soil is poor, but from the abundance of rock and general roughness of the land. This region is well adapted to grazing.

In the anthracite region and the serpentine barrens of the north-east much of the soil is worthless. It is destitute of grass and, except a variety of laurel, has little or no vegetation.

Climate.—The climate of so large a State must of necessity differ greatly in various localities. The eastern and western belts have nearly the average temperature, being rather cooler in the northern than in the southern parts.

The middle belt is subject to much greater extremes of temperature. In the northern part of this belt the winters are extremely cold, and snow often covers the ground for four months of the year. In the southern part, the winters are much milder, but the narrow valleys are often intolerably hot in summer.

The rainfall varies from 37 inches in the eastern to 43 in the western part—enough to furnish an abundance

of moisture to every part of the State. Thunder storms are frequent, but not unusually violent. The tornadoes that are so frequent in the Mississippi Valley rarely occur in Pennsylvania.

There are weather-bureau stations at Philadelphia, Erie, Pittsburgh and Williamsport. At these stations daily reports and indications of the weather are received, and from them distributed to various parts of the State. There are also stations at Brownsville, Freeport, Confluence, New Geneva and Oil City, where the rise and fall of the river are observed, and cautionary signals exhibited.

Vegetation.—Much of the highland region is covered with growths of oak. Pine is also abundant, and many million feet of pine timber are yearly floated down the streams which drain the middle belt.

Hemlock, beech, chestnut, maple, sugar-maple, walnut, hickory and ash, are also important lumber-yielding trees. The wild cherry, wild grape, whortleberry, wild strawberry, raspberry, blackberry, persimmon and wild plum are still abundant. In addition to these are the various cultivated grains, fruits, grasses and other plants of economical use which have been introduced since the advent of the white men.

During past years the destruction of forestry has been enormous. The iron furnaces have cleared large areas, forest fires have destroyed extensive tracts, and many thousand trees have been 'barked' to supply the tanneries. The enormous demand for railway sleepers and for building lumber has also served nearly to clear the State of available timber.

Animal Life.—Few States in the Union have a greater variety of animal life than is to be found in Pennsylvania. The deer and the fox are more or less common in various parts of the State. The black bear, puma or panther, and wild-cat are still to be found in the mountain fastnesses. A species of small wolf is occasionally met with, and small game, such as the weasel, hedge-hog, ground-hog and squirrel are common.

The eagle, hawk and carnivorous birds of several species, together with the pheasant, partridge and other game birds are still common. The wild turkey is rarely seen, but wild water-fowl are abundant along the streams. Nearly one hundred and forty varieties of fish have been found in the rivers and littoral waters of the State, many of them being excellent for food. The shad caught in Delaware River and Bay are famous for their excellence. The U. S. Fish Commission have established hatching stations at Corry, and Marietta, near Lancaster. The 'fry,' consisting mainly of salmon, shad, and trout, are distributed among the streams of the State.

Of the reptiles found within the State only two are venomous, the copperhead and the rattlesnake. The former is rarely seen. Rattlesnakes are common in the mountains, and, in spite of their natural enemies, the black snake, deer, and hog, they resist extermination.

QUESTIONS.

To the Teacher.—It is well to have specimens of the different *types* of soil kept where pupils can have access to them. Wide-mouthed bottles are handy for this purpose. Gravel and sand should be in their natural state; red loam and black loam should be sifted; clay should be in large selected lumps which will show its tenacious quality. Instruct pupils in the names and properties of the various plants in the neighborhood. Have good specimens of the various kinds of building and ornamental timber,—one side

showing the bark, the other side dressed so as to show the grain of the piece. Keep them where they can be handled by the pupils, and insist on their preservation. It is well to have a herbarium consisting of useful medicinal plants, grasses, and a few ornamental plants. Display the flower, one or more leaves, part of the stalk and cleaned root of the larger plants; the smaller ones may be preserved entire. Encourage the pupils to collect and teach them how to press and display the plants. Familiarize pupils with such insects and birds as are injurious, and with those that are beneficial to the farmer. Instruct them how to read the thermometer, and if possible the barometer. Explain the causes of dew, fog, rain, and snow, and teach the various forms of clouds. Have them observe the direction from which storm-bearing winds usually come, and impress on them the fact that the storm nearly always clears up with the wind in the opposite direction. Prepare a set of weather flags, such as are used in the U. S. Weather Bureau, and teach the manner of their use. Read the chapter entitled The Weather Bureau.

What kinds of soil are found in the neighborhood where you live?

When is soil poor, and when fertile?

Do all plants require the same kind of soil?

How can worn-out soil be made productive?

Can you raise grain year after year on the same land and have good crops at the end of several years?

Can you tell what minerals a plant takes from the soil?

What is said about the climate of the State?

In what part will you find the coldest weather?

Which has the greater rainfall, the eastern or the western part of the State?

In what cities are there weather stations?

Can you tell what the different weather flags mean

What is a tornado?

What would be the result if there were no rain?

Where does the rain come from?

Where do the clouds come from?

What kind of forest trees grow in your neighborhood?

Is any of the timber used to make lumber?

What kinds of wood are noted for hardness and strength? What kinds of wood are soft? What kinds are mainly used in building houses? What kind are useful for their bark?

What kinds of wild fruit are found in the State?

Along what rivers is most of the timber obtained? How is it sent to market?

Of what use are oak and hemlock bark?

What are railway sleepers?

Make a list of the wild animals you have seen that are found in the State.

Can you name any birds and insects that are injurious to the farmer? Why? Can you name any that are beneficial? Why?

What birds and what insects are injurious to fruit trees?

What kinds of fish in the streams near where you live?

Why are rattlesnakes so called? How do black snakes, deer, and hogs kill them?

In what towns of the State are there fish-hatching stations?

V.

MINERAL WEALTH.—COAL.

No other State in the Union surpasses Pennsylvania in the extent and wealth of mineral products. Nearly all the anthracite coal, a large part of the bituminous coal, three-fourths of the petroleum, and about half the pig-iron produced in the United States are obtained from the mines in Pennsylvania.

Coal.—The anthracite coal-fields are mainly in the heart of the Appalachian Mountains and are commonly designated as the northern, middle, and southern fields. They underlie an area of rather less than five hundred square miles. Most of the collieries of the northern fields are near Scranton, Pittston, and Wilkesbarre. Mahanoy City, Shenandoah and Shamokin are the chief centres of the middle field. The southern field, though large, has fewer productive collieries. These are mainly between Pottsville, Tamaqua and Mauch Chunk.

One of the largest seams, Mammoth Vein, has a depth of nearly sixty feet. In some instances ten or twelve seams have been penetrated in sinking a single shaft. These fields are small compared with those of the bituminous coal, and it is thought that the supply will last hardly more than two hundred years.

The bituminous fields lie mainly west of the Appalachian Mountains, and extend through every county west of the Alleghany Mountains, in seams varying from the thickness of a sheet of paper to that of twelve feet.

Seams less than three feet in thickness are not commonly worked with profit.

There are many sorts of bituminous coal, but they differ only in the amount of volatile matter, such as illuminating-gas, coal-tar, etc., which they contain. A kind called semi-bituminous is much like ordinary anthracite coal. Another variety known as splint or block-coal contains about thirty-five per cent of gas. It is much used in the manufacture of illuminating gas, and in the smelting of certain kinds of iron ore.

QUESTIONS.

To the Teacher.—Have the pupils read carefully the chapter on Coal in the second part of the manual. Procure specimens of graphite, anthracite, block, common bituminous, and cannel coals. Add to these specimens of coke, charcoal and lamp-black; if possible, also a diamond to complete the series. Impress the pupils with the fact that all these minerals are forms of carbon, and that they differ in appearance only. Fragments of coal-bearing rock showing the prints of ferns, equisetæ, and other plants of the coal period may be readily procured. These will furnish very instructive object-lessons concerning the vegetable origin of coal. It will be a good plan, also, to demonstrate that anthracite coal is nearly pure carbon, while bituminous coal contains a mixture of hydro-carbon compounds. This can be easily done by placing a piece of soft coal in a clay pipe, luting the bowl with clay, and heating it over the flame of an alcohol lamp. The smoke which escapes through the stem of the pipe is an impure illuminating gas, and may be lighted as it escapes. More or less coal-tar is condensed in the stem, and there finally remains in the bowl a piece of coke, which does not differ except in form from anthracite coal. Like anthracite it burns with but little flame and no visible smoke. Encourage the pupils to distinguish the different varieties of coal.

In what part of the State is anthracite coal found?

In what counties is each of the three fields or basins?

What is the difference between anthracite and bituminous coal in appearance? in hardness? in behavior when burned?

Can you describe how it is obtained?

What is a coal-breaker?

How is the coal sorted so that blocks of the same size are collected together?

What is the shaft of a mine? What are the pillars?

How many pounds of coal in a long ton? in a short ton?

How thick are the coal seams?

Name five towns or cities that are known as coal-mining towns.

To what cities is most of the anthracite coal shipped? the bituminous coal?

How is the coal conveyed to the various markets?

How does Pennsylvania compare with other States in the production of coal?

In what counties is most of the bituminous coal mined?

How is coke made?

For what is it used?

Can you describe how the coal-beds were formed?

Will graphite or 'black lead' burn?

For what is it mainly used?

Is it made from, or does it contain, any lead?

Can you tell why coal is sometimes called 'condensed sun-heat?'

Explain the way in which coal becomes a force.

Which can do the most work in a day, a strong man or a pound of coal?

VI.

MINERAL WEALTH.—IRON AND OTHER MINERALS.

Iron.—Iron ore is widely distributed over the State. The most productive deposits occur at the famous Cornwall mines in Lebanon county. Another valuable deposit in Oley Valley, Berks county, yields a metal fully equal to the best Swedish iron. Much of the iron product of the State comes from the ore-deposits of Michigan and New York, which is sent to the smelters of Pennsylvania for shipment.

Petroleum.—Petroleum or 'rock-oil' was first brought into general notice in 1859. Since that time the production has enormously increased until at the present time the refined oil under the names of 'coal-oil' and 'kerosene' is shipped to all parts of the civilized world. Petroleum was first produced in Venango county. Since that time the oil-horizon has been found to underlie nearly the whole basin of the Alleghany River.

Natural Gas.—Natural gas is abundant in the western part of the State. It does not differ materially in quality from that manufactured at the gas works, and in many of the cities and towns in the western part of the State it is used for both lighting and heating purposes. In the city of Pittsburgh it has almost entirely supplanted the use of coal for generating steam.

Salt.—Salt occurs in the western part of the State. Many of the salt deposits underlie beds of bituminous coal.

Zinc is found in several localities, notably at Friedensville.

Nickel is obtained at the famous Gap Mine near Lancaster. Much of the metal taken from this mine is used in the manufacture of three-cent and five-cent coins of the United States. Quarries of marble and other building stone are numerous, and yield an abundance of slate, sand-stone, flag-stones, and granite.

QUESTIONS.

To the Teacher.—Have the pupils read the chapters on Iron, Petroleum and Natural Gas at the end of the manual. If possible procure the following: Several pieces each of iron ore, pig iron, spiegel iron (used in making steel), fine cast iron showing fresh fracture, wrought iron and steel. It is an instructive experiment, and one easily made to fuse a piece of iron ore, the size of a shot, with a blow-pipe on charcoal. It is best to pulverize the ore and mix it with about twice as much baking soda. Make a little cavity in the charcoal in which the ore may be placed and fuse the mixture for two or three minutes. If fairly well done, a globule of metallic iron will be formed. By skillful questioning develop the physical differences between cast iron and wrought iron. Explain as well as you can the manner in which steel is made. Procure specimens of crude petroleum, refined oil and naphtha. Keep them in *closely sealed* bottles. Make a saturated solution of common salt and place in it several short pieces of thread on which the crystals of salt may form. Let each pupil examine the crystals with a magnifying glass in order to note the cubical shape of the crystals. Procure also pieces of slate, marble, sand-stone, granite and other building stone that may be found in the neighborhood. Pieces of zinc and nickel and their ores will also be useful.

Is iron taken from the earth in the form of a metal?

Can you describe the manner in which the metal is obtained from the ore?

With what kinds of iron ore are you acquainted?

What minerals are used in smelting iron?

What is pig iron? cast iron?

What is the difference between cast iron and wrought iron?

Would cast iron be suitable for making railway rails or engine-boilers? Why?

Why are watch-springs, knife-blades, etc., made of steel instead of iron?

Why is a pound of iron made into watch-springs worth more than a pound of ordinary cast iron?

In what counties of the State is iron ore mined?

Is all the iron produced in the State made from Pennsylvania ore?

What State produces the most iron ore? *Ans.*—Michigan produces the most ore; Pennsylvania manufactures the most iron. The Gogebic mines of Michigan are celebrated for the quality of their ore.

For what is petroleum used?

Can you describe the manner in which it is obtained?

What is meant by 'striking oil'?

What is a 'spouter'?

What is meant by 'torpedoing' a well?

Is petroleum itself ever used for burning in lamps?

What is a refinery?

What useful substances are obtained from petroleum?

In what ways is petroleum sent to market?

What is a pipe-line? a tank car?

In what part of the State is petroleum mined? in what river basin?

What counties produce large quantities of it?

How is natural gas obtained?

For what is it used?

Of two manufacturing establishments, one using coal and the other gas for generating steam, which would be more likely to prosper? Why?

Can you describe the way in which gas is used to generate steam?

In what part of the State is natural gas most abundant?

Name one or more cities which are lighted and heated by it.

For what is salt used? How is it obtained?

Where is zinc found? Name some of its uses.

For what is nickel used?

How does nickel compare with silver in color? in luster? in hardness?

In what part of the State is it found?

VII.

INDUSTRIES.

Because of the variety and abundance of the natural resources of the State, there is a great diversity of industries. Probably in no other densely peopled State are the main industries, agriculture, mining, and manufacture so evenly balanced.

Agriculture.—Since the first settlement of the State agriculture has been a leading employment, and in spite of the great amount of unproductive land, the State ranks among the foremost in the value of its farms and farm-products. Hay, corn, wheat, oats and tobacco are the most valuable crops, and there are now nearly a quarter of a million farms under cultivation.

Garden, dairy, and fruit-farming are extensively carried on in the south-eastern part of the State, where the population is densest, and in the value of the products this State is surpassed by New York only. Stock-farming is carried on mainly in the middle belt. During late years much attention has been given to the raising of thoroughbred stock.

Mining.—In mining Pennsylvania is and probably will always be the foremost State in the Union. Even with the rapid development of mining in other States, the out-put of the mines is almost equal to that of all the other States combined. Luzerne, Schuylkill and Lackawanna counties produce four-fifths of the anthra-

cite; the five south-western counties nearly all the bituminous coal.

Iron is mined in more than thirty counties, Lehigh, Lebanon, Berks and Blair yielding an aggregate of about 750,000 tons.

Of the 30,000,000 barrels of petroleum annually produced, Warren and McKean counties yield by far the largest supply.

The total value of the crude mineral products in 1880 was about $200,000,000, the production of which gave employment to 150,000 people. In the ten years succeeding, the value of the mining out-put has nearly doubled.

Manufactures.—The manufactures of the State surpass those of every other State except New York. The products of iron and steel are nearly equal to those of all the remaining States combined, and of the total manufacture of crucible or Bessemer steel three-fourths are manufactured in Pennsylvania. The quality of the product is not surpassed in any other part of the world.

The iron-ship yards on Delaware River, the locomotive building-shops, the glass-works, the tanneries, and the lumber-product—all unsurpassed elsewhere in the United States—bear testimony to the enterprise of Pennsylvania. The value of the manufactures is not far from $800,000,000 yearly.

Lumbering is also an important industry, and in the value of the yearly product, Pennsylvania is one of the foremost States. The pine forest along the Susquehanna and the hemlock of the north-western counties yield an annual supply of about 700,000,000 feet of

lumber. The bark of the hemlock is used in tanning leather, and the tanneries of the hemlock region are among the largest in the world.

QUESTIONS.

To the Teacher.—It is well to impress the fact that the industries of mankind are the outgrowth of civilization, and at the same time civilization and enlightenment are the outgrowth of industry. They go hand in hand, and are mutually dependent. Both are the result of hunger. The mines, the mills, the farms, the railways and the steamships have no other use than to enable us to procure food and bodily comfort. Our schools educate us, so that by making ourselves useful, we can the more easily feed and clothe ourselves. Perhaps some doubting pupil will ask if each individual might not plant his own grain, herd his own cattle, make his own tools and his own clothing. Yes, all this might be done. As a matter of fact, there are certain people who live in this manner, but unfortunately they are savages. Impress also the fact that the distribution of various industries is controlled by geographical laws, which man cannot easily modify. One cannot profitably cultivate wheat in the anthracite coal region, raise cattle in Philadelphia, nor mine coal in Lancaster county. Silk culture would not be profitable in Alaska, nor seal-fisheries in Pittsburg. In short, industries thrive only where the natural resources which underlie them are found.

What are the principal products of the farms of Pennsylvania?

For what are the hay, oats and corn mainly used? the wheat?

In what part of the State is tobacco raised. *Ans.*—In Chester, Lancaster, and York counties.

What is meant by garden-farming? dairy-farming? Why are garden-farms and dairies most profitable near large cities?

What is stock-farming, and in what part of the State is it carried on?

What is said of the value of the farms in the State?

What is the rank of the State in mining?

How does the coal out-put compare with that of the rest of the United States?

Name some of the uses to which coal is put.

How is it carried to market?

Name two cities in the United States that are extensive markets for anthracite coal. One that is a market for bituminous coal.

Which counties produce most of the anthracite coal?

Which produce most of the bituminous coal?

In how many counties is iron mined? Which counties produce the most?

What is the value of a ton of coal at the mines? of a ton of pig iron?

What is the value of a steel rail of ordinary size?

What is ordinarily the yearly yield of petroleum?

Which counties yield the greater part?

What was the value of the crude mineral products in 1880?

Is the value of the out-put increasing or diminishing?

In what part of the State are iron and steel manufactures chiefly carried on?

What is meant by crucible or Bessemer steel?

In what part of the State are the iron-ship yards?

In what city are most of the textile goods manufactured?

What is the yearly value of the manufactures?

In what part of the State is lumbering carried on? Why?

Where are the tanneries? Why?

VIII.

COMMERCE AND TRANSPORTATION.

In its commercial relations the State holds a high rank. Foreign commerce, however, is somewhat crippled by the distance of Philadelphia from the ocean, and the expensive pilotage on Delaware Bay and River. The main outlets by water are—to the Atlantic Ocean through Delaware River, to the Great Lakes through Lake Erie, and to the Mississippi by way of the Ohio.

Philadelphia, Erie, and Pittsburgh are ports of entry. Most of the foreign commerce centres at Philadelphia. The trade with the various ports of the Great Lakes extends mainly from Erie. That of the Mississippi Valley and the Gulf States radiates from Pittsburgh.

The railways of the State have an aggregate mileage of 7,700 miles, built at a cost of over $500,000,000. The Pennsylvania system controls about seventy lines with termini at Pittsburgh, Chicago, Buffalo, New York, St. Louis and Washington. Through connections are made with Boston, Cincinnati, Louisville, Memphis, New Orleans, and other points in the South and West. The Philadelphia and Reading covers the State with a net-work of tracks, its mileage being a little less than that of the Pennsylvania.

The Baltimore and Ohio is a trunk line between New York, Cincinnati, St. Louis and Chicago. The Lehigh Valley is operated as a trunk line between Philadelphia (and New York) and Buffalo. The Pennsylvania con-

trols a number of leased lines which traverse the western part of the State, connecting Pittsburgh with the ports of the Great Lakes.

The canals have been largely supplanted by the railway, but nearly 900 miles of canal are still kept open. The Pennsylvania canal which follows the course of the Susquehanna River and its branches is 358 miles long. It is used mainly for the transportation of coal and iron. The Delaware, Schuylkill and Lehigh Rivers are also flanked by canals. The Delaware and Hudson Canal connects the two rivers of the same names at Honesdale, and at Kingston, N. Y.

Long lines of pipe for the delivery of petroleum form one of the interesting features of commerce. These pipe lines radiating from the oil region, reach to Buffalo, Pittsburgh, Philadelphia, and New York. The oil is pumped into the distributing reservoirs and flows to the receiving tanks in the cities named.

QUESTIONS.

To the Teacher.—It will be a good plan to dwell on the enormous development of railways in the United States. In 1890, they had an aggregate mileage of about 170,000 miles, nearly equal to that of all the rest of the world together. Develop the fact that the railway has almost entirely superseded the stage coach, the canal boat and the river-steamer. Impress the fact that although railway transportation costs more than carriage by steamer, or barge, it is also a much quicker method, but that is less expensive than carriage by the ox-teams of half a century ago. Explain what is meant by the Inter-State Commerce Law, pools, long haul, short haul, etc. Explain also the manner in which freight is classified and the reasons for so doing. Instruct the pupils also with reference to the cost per mile of freight and of passage. On most of the roads of Pennsylvania the passenger-rates are three cents per mile for one-way tickets, two and a half cents for excursion tickets, and two cents per mile for mileage books of 1,000 miles each. Freight rates vary much, and tickets to remote points are sometimes higher than to intermediate points where there is no competition.

What is meant by foreign commerce? domestic commerce?

Give a reason for the decline of the foreign commerce of the State.

What is meant by *pilotage* and *towage?*

What natural outlets by water has the State to the Atlantic Ocean? the Great Lakes? the Mississippi Valley?

In what city does most of the foreign commerce center? the lake commerce?

What are ports of entry?

Name the ports of entry in Pennsylvania.

Name the principal lines of railway in the State.

Write the abreviations for each.

What is meant by the termini (*sing.*, terminus) of a railway?

What is a trunk line?

Can you name ten different kinds of cars used on a railway?

What is a switch? a turn-table? a round-house? a gravity road? a side-track?

What flag or light is used as a danger signal?

What is meant by an automatic brake?

Name the principal termini of the Pennsylvania Railway, the Philadelphia and Reading, the Baltimore and Ohio, the Lehigh Valley.

By what lines can you go from Philadelphia to Pittsburgh? Pittsburgh to Buffalo? Philadelphia to Chicago?

Name the railways that pass through the city or town in which you live.

By what routes can you go to Philadelphia? Pittsburgh? Chicago? New York? Washington? Buffalo?

Name the principal canals of the State.

What canal connects Delaware and Hudson Rivers?

For what kind of freightage are the canals mainly used?

Where is the Pennsylvania canal?

How may canals be serviceable in checking exorbitant freight-rates by railway?

What cities are connected with the oil-fields by pipe-lines?

IX.

GOVERNMENT.

Pennsylvania is officially styled the Commonwealth of Pennsylvania, and is represented in Congress by two Senators and twenty-eight Representatives. The administration of the State government is vested in three departments, the Executive, the Legislative and the Judicial.

The Executive Department is administered by the Governor, Lieutenant-Governor, and Secretary of Internal Affairs, whose terms of office are four years; an Auditor-General elected for three years, and a State Treasurer elected for two years. The Governor appoints a Secretary of the Commonwealth and the Attorney-General to hold office during his pleasure, and the Superintendent of Public Instruction for a term of four years.

The Legislative Department consists of a Senate of 50, and a House of Representatives of 204 members. The Legislature convenes the first Tuesday of January of odd-numbered years. Senators are elected for four, Representatives for two years.

The Judicial Department is vested in a Supreme Court, Courts of Common Pleas, and such lower and special courts as may be authorized. The Justices of the Supreme Court, seven in number, are elected each for a term of twenty-one years. Judges of the Court of Common Pleas are chosen each for a term of ten years.

Including the city and county of Philadelphia, which are co-extensive, the State is divided into 67 counties. Certain laws and regulations of the State are administered by county government. In some of the larger counties there are necessarily more officers than in the smaller counties. Nearly all the county officers are elected by the people for a term of three years. The County Superintendent of schools is elected by the School Directors. The following are the principal county officers:

Sheriff,	Prothonotary,
Three Poor Directors,	Recorder of Deeds,
District Attorney,	Clerk of Courts,
Three Commissioners,	Register of Wills,
Three Auditors,	Coroner,
Two Jury Commissioners,	Treasurer.

Township and borough government is administered by Justices of the Peace and Constables, who preserve order and punish minor offences. Assessors, Clerks, and Auditors manage financial matters. Supervisors of Highways regulate the building and repair of public roads. School Directors have charge of the schools of their respective School Districts, which generally consist of a borough or a township.

There are two penitentiaries, one at Philadelphia, and the other at Allegheny City; and a reformatory for young criminals at Huntingdon. Reform schools for incorrigible youth have been established at Philadelphia and at Morganza, near Pittsburgh. Nearly every county has a poor-house, and a jail.

QUESTIONS.

To the Teacher.—No faithful instructor will fail to impress on the minds of the pupils that while citizenship has rights, it also has duties, which cannot be lightly laid aside. One of these duties—an imperative one—is to learn how the state is governed. No one not acquainted with the essential principles of state government can claim to be an intelligent citizen. He

may be an educated and a law-abiding *man*, but he is neither an intelligent nor a good citizen. He is not an intelligent citizen, because he is ignorant of his rights; he is not a good citizen, because while the state protects his life and property, he has neglected to do those duties which the state imposes on him. Another duty is the exercise of the right to vote. A man who neglects to vote is undutiful to the state and ungrateful to his neighbors. There are but few countries in the world in which the people have the privilege of determining how they shall be governed, and still fewer in which they have the right to govern themselves. It is well to bear in mind also that the public schools are not designed for the purpose of making farmers, mechanics, merchants, and professional men, but rather to instruct the youth of the state in those elements of learning which will make them honest, intelligent, and dutiful citizens.

What is the official title of the State?

By how many Senators is it represented in Congress? by how many Representatives?

In what manner, and for how long a term is a United States Senator elected? a representative to Congress?

Name one or more reasons for dividing the State government into three departments.

What are the chief executive officers? Which is the highest in rank? Which executive officers are elected? Which appointed?

What is the difference between appointing and electing an officer?

What are the chief duties of the Governor? the Secretary of Internal Affairs? the Treasurer? the Superintendent of Public Instruction?

Who are at present holding these offices?

What body confirms an appointed officer?

What are the functions of the Legislative Department?

Of how many members does the State Senate consist? the House of Representatives?

For how long a term is each elected?

How does an act proposed in the Legislature become a law?

What is meant by *vetoing* a bill? What officer exercises this right? How can a vetoed bill become a law?

What are the functions of the Judicial Department?

What is the highest court in the State? Of how many justices is it composed? What is meant by the Supreme Court's *sitting in banc?*

What other courts are authorized in the State? What is a Police Court? a Justice Court?

By whom is a prisoner sentenced to loss of life or liberty?

Can any person be deprived of life or liberty without trial?

By whom is a prisoner declared innocent or guilty?

Into how many counties is the State divided?

Name the counties surrounding the one in which you live.

Which is the largest county in the State? the smallest? the central?

Name the principal officers of a county.

What are the duties of each?

How is the County Superintendent of Schools elected?

What are the principal officers of a township?

What is the difference between a city and a town?

What is the chief officer of a city called?

What is the difference between a constable and a policeman?

Under what circumstances may a man be arrested without a warrant? What is a warrant?

What is a penitentiary? a jail? a hospital? a poor-house? an insane asylum?

X.

EDUCATION.

Education.—The first common school in what now constitutes the State of Pennsylvania was established in the Dutch settlement of New Netherlands, in 1657. The charter government authorized by William Penn encouraged the establishment of schools, and the constitution of 1790 provided a system of schools in which 'instruction to the *poor* should be free.'

The system of schools founded on this last-named unwise provision was not successful, and in 1834 the schools were made free to all. During successive years the powers of school officers were enlarged, and provisions made for a superintendent of schools in each county. (Act of 1854).

Since then the facilities for acquiring education have constantly increased. Twelve normal schools have been established for the training of teachers. Institutes are held yearly in each county, conducted by the best educational talent that can be procured. These institutes, which are attended by an aggregate of 17,000 teachers, are not equalled by those in any other State in the Union.

During the past ten years great encouragement has been given to industrial education and manual training, and there is a growing belief that the hand should be taught to do what the mind conceives. Many schools for technical training have been already established, and

effort to incorporate such instruction as a fundamental principle of public instruction is daily gathering strength.

Higher education has always been encouraged, and the large number of colleges bears evidence of its value. The University of Pennsylvania and Dickinson College at Carlisle are each more than one hundred years old. The doors of the latter are thrown open to women. Lafayette College at Easton is an old and noted institution, and Lehigh University at Bethlehem is among the finest schools of technology on the continent. Pennsylvania State College in Center County is partly supported by the State, and gives free tuition in agriculture and the sciences. High schools are established in all the larger towns and boroughs, and many of them are famous for their excellence. But the country schools are the stronghold of the State, and these, with their graded courses of study are the true colleges in which the youth of the State receive their first lessons in citizenship.

The various colleges of medicine, dentistry, and pharmacy stand among the foremost in the country. Of the various technical and art schools, the Boys' school of Manual Training, Girard College, the Woman's School of Design, and the Academy of the Fine Arts have a national reputation. The colleges of medicine and dentistry draw students from all parts of the world.

The present system of education is a monument of honor to the founders of the Commonwealth. To Thaddeus Stevens, more than to any other one man, this honor is due, and the life that he infused into it has been kept up by such educators as Burrowes, Wickersham, and Higbee.

See list of Colleges in Part II.

QUESTIONS.

To the Teacher.—It is well to emphasize the enormous amount of money spent by the State for the education of the youth of the State—in the average $7,500,000 yearly. This sum however is about one-eighth the amount spent for liquor during the same period. In the total expenditure for educational purposes Pennsylvania is the fourth State in rank; in the expenditure per capita, the 23d (Nevada is first, California second, and Massachusetts third). It is well to appreciate the fact that this expenditure is designed to promote that kind of development which produces patriotism, strength of character, and usefulness to the community. The world does not care how much a man knows; it values him only for *what he can do.* Intellectual culture is an excellent acquisition, but unless it is of a kind which develops force of character and ability to do, it is a source of weakness and unhappiness rather than of strength. That man is the best educated who is the most useful to his fellow men.

When was the first school of which there is any record established in Pennsylvania territory?

What were William Penn's ideas of the importance of schools?

What is said of the 'poor-schools' established in 1790?

Why would such a system of schools naturally result in failure?

Why ought they to fail? *Ans.*—If for no other reason, for the fact that such schools would necessarily create a class distinction founded on the possession of wealth. Such a spirit is totally incompatible with the true idea of a republican government. The only distinction permissable in a school should be founded on integrity of character, perseverance and faithfulness to duty.

When was the present school-system established?

What are the duties of a county superintendent of schools?

How is he elected?

What are some of the powers and duties of school trustees?

How are they elected?

What are the duties of a teacher? What legal qualifications must the teacher have?

What are the duties of each pupil?

What are normal schools? What normal school is nearest to the place where you live?

In what college is the tuition free in agriculture and scientific studies?

Name some of the prominent colleges and universities in the State.

What is meant by 'manual training' in schools?

What is a kindergarten?

What is a medical college? a college of pharmacy? a college of dentistry?

How are the schools of the State supported?

Can women hold educational offices in the State?

XI.

HISTORY.

Long before the settlement of what now constitutes the State of Pennsylvania, an Indian tribe known as the Delawares controlled the eastern slope of the State, and a powerful confederacy of Indians called the Six Nations controlled a vast area west of the mountain belt.

As early as 1623 the Dutch West India Company obtained a foothold along Delaware River, claiming the land on both sides of the stream. Settlements were made, however, on the *east* side only. In 1643, Minuit, at one time an officer in the company, but afterwards in the employ of the Swedish government, took possession of the land on the *west* bank of the river.

Minuit claimed all the land along the west bank of the river from Cape Henlopen to the site of Trenton. He built a fort at Wilmington, Delaware. After Minuit's death, a few years following, another fort was built on Tinicum Island, and two years later, in 1645, a permanent settlement was made at Upland, now adjoining the city of Chester.

In 1655, Peter Stuyvesant, the Governor of the Dutch possessions in America, appeared on the scene with seven vessels and six hundred soldiers. His demand for the surrender of the territory was immediately complied with. The victory was a bloodless one and the people

were left in peaceful possession of their homes and property.

In 1664 during the war between England and the Netherlands, an English fleet under the Duke of York sailed up Delaware River, and with hardly a show of resistance, all the Dutch possessions passed into the hands of the English. In 1681, a large part of the tract of land involved was given by Charles II. of England to William, a son of Admiral Penn, in payment of a debt of £16,000 owed to the latter. The grant of land extended from the Delaware five degrees westward.

Penn belonged to a religious sect known as the Society of Friends, or 'Quakers.' He had suffered much from religious persecution, and looked to America as a place where he and his followers could live in peace. Crossing the ocean in the ship Welcome, he selected a tract of land near the junction of the Schuylkill and Delaware Rivers as the site for his colony. He called a conference of the Indian chiefs, whom he also paid for the land, and thus was begun the city of Philadelphia.

According to tradition, Penn's treaty was made on a spot near the village of Kensington, now included in the limits of Philadelphia. An old elm-tree which formerly marked the sight of the spot has since been replaced by an unpretentious monument. There was not a scrap of paper nor a line of writing to witness this treaty, but nothwithstanding it was faithfully kept for more than fifty years.

The frame of Penn's government was wisely drawn and the colonly grew rapidly by the addition of emigrants from England, Scotland, Germany, Ireland, France, and Wales. In twenty years the colony num-

bered more than 70,000 souls. The heterogeneous mixture of people, differing greatly in customs, religion and political belief, was not conducive to peace, and as a result there was much wrangling during the century following.

The French and Indian wars were the serious troubles during the colonial period. These wars were marked by Braddock's defeat near Pittsburgh, and the capture of Fort Du Quesne. It was during these scenes that George Washington first achieved distinction.

In the final struggle of the American colonies for independence Pennsylvania bears an enviable record. The historical session of Congress during which independence was declared convened in Philadelphia. The battles of Brandywine and Germantown, the capture of Philadelphia and Fort Mifflin, all took place on Pennsylvania soil. There is scarcely a spot in Philadelphia, Montgomery and Delaware Counties that has not a historical connection with the War of the Revolution.

During the past century, as a part of the great republic, the State has won a leading place, and its one hundred years of existence have been a history of unparalleled prosperity.

QUESTIONS.

To the Teacher.—The main facts of the general history of the State are easily accessible, but the local history of the town and the county is rarely found in any published work. The author earnestly recommends that the compilation of local history be made a point of the regular school work. Every pupil can obtain interesting and important facts of history which as yet are unwritten. Much of the material of Bancroft's History of the Pacific Coast was compiled by the pupils of the public schools of California, Nevada and Oregon. Indeed the most accurate history of California during the gold-mining excitement was compiled by the children of California. It is an interesting study, also, to learn the characteristics of the various people who have made up the population of the State, especially the Indians, the Friends or 'Quakers,' and the Germans. Note the fact that the people commonly called Pennsylvania Dutch are not from the Netherlands, but from Germany.

It is well to impress the fact that while the Dutch and the Swedes came to this country mainly to trade with the Indians, the English came for the purpose of making homes. This was an element of strength which gave them no little superiority in the final struggle for the possession of the country.

Who controlled the territory now included in the State before the advent of the white man?

Who were the Five Nations? *Ans.*—The Mohawks, Oneidas, Onondagas, Cayugas, and Senecas. These were also known as the Algonquins, and as the Iroquois Confederacy. They were afterwards joined by the Tuscaroras, and were then known as the Six Nations.

What was the territory claimed by the Dutch East India Company? On which bank of the Delaware River were their settlements made?

What was the teritory occupied by the Swedes?

What settlements were made by Minuit?

Where is Tinicum Island? Uplandt?

Who was Peter Stuyvesant?

Describe the capture of the Swedish settlements. What caused the final transfer of this territory to the English? How came it to be deeded to William Penn?

Can you tell any of the characteristics of the Friends? How came they to be called Quakers?

What was Penn's conduct towards the Indians?

What parts of Pennsylvania were battle grounds during the French and Indian war?

Can you describe any of the circumstances concerning Braddock's defeat? What officer of the colonial troops who took part in this battle afterwards became distinguished? Where was Fort Du Quesne ?

Name some of the battles of the Revolutionary war which took place in Pennsylvania.

Where is Brandywine Creek? Germantown? Fort Mifflin? Valley Forge?

Whereabouts on the Delaware River did Washington make a crossing at the time of the capture of Trenton, N. J.?

What famous battle of the civil war occurred in Pennsylvania?

What two centennial celebrations have taken place in Pennsylvania? What did each commemorate?

XII.

CITIES AND TOWNS.

NOTE.—The questions and other exercises on cities and towns are better left to the judgment of the teacher. The geography of other centres of settlement should be largely interwoven with the geography of the city or town in which the pupil lives, at the same time treating each important town or city as a centre of the particular industry which has given it life. Each pupil should be required to make a map of the county in which he lives, and the teacher should see that the topography, drainage and transportation lines are reasonably correct. The geography of the county should be studied from these maps while the pupils are making them.

In 1880 there were seventeen cities, boroughs and towns with a population of 10,000 and over. At the beginning of 1890 twenty-five cities and towns were estimated to contain at least this number of people.

THE EASTERN SECTION.

Philadelphia, the metropolis of the eastern part of the State, is situated on Delaware River, and the densely settled part lies mainly between this river and the Schuylkill. It covers an area of 129 square miles, and in extent of territory exceeds every other city in America or Europe, except New Orleans. During the past one hundred years its limits have been gradually extended until it now embraces the villages of Frankford, Kensington, Mantua, Southwark, Richmond, Germantown, Chestnut Hill, Torresdale, Holmesburg, Bridesburg, Manayunk, and a number of small villages.

In population it stands third in the United States, exceeded only by Chicago and New York. In the value of its manufactures and the extent of its com-

merce and manufactures it is among the foremost cities of the continent. Its establishments for the manufacture of iron and steel and textile goods are among the largest in the world. The Baldwin Locomotive Works turn out an average of more than three locomotives a working day, making in 1889 one thousand locomotives. The ship-yards of Cramp & Sons are the largest in the world, those of the River Clyde excepted. Most of the iron vessels of the United States Navy are built at these yards.

The woolen and worsted goods made in this city are distributed in every State and territory in the Union. The surgical, dental and optical goods are not surpassed by those of any other country. It is the largest coal market in the United States, and contains the largest retail stores in the world. The sugar refineries alone produce sugar to the amount of $25,000,000 a year, and the total value of the manufactured products is upwards of $500,000,000 yearly.

In no other city in the United States does the laboring man fare so well as in Philadelphia. There is scarcely a tenement house in the whole city; there are thousands of small houses equipped with all the conveniences which sanitary science can provide, which may be rented for a sum within the reach of the poorest-paid laborer. Added to these advantages is Fairmount Park, also a conservator of public health and morals. The park is traversed by Schuylkill River and Wissahickon Creek, and more than sixty miles of carriage-roads and foot-paths wind about the more picturesque parts.

In 1887 the commerce of the city amounted to a total of about $70,000,000. Up to 1830 Philadelphia was the foremost commercial port in the United States. Since that time the commercial interests have steadily declined.

There are steamship lines to Liverpool, Glasgow, New York, Boston, Savannah and Charleston. Three trunk lines of railway, the Pennsylvania, the Philadelphia & Reading and the Baltimore & Ohio pass through the city. About fifteen local railways center in the city.

The business part of the city is noted for its massive buildings and fine architecture. The new City Hall with its court-yard covers four and one-half acres. Its tower when completed will reach a height of 537 feet, exceeding that of any other building on the continent except Washington monument. The residences on North Broad street are not surpassed by those in any other city in the United States. Among other notable public buildings are the Post-office, the Custom House, and the United States Mint.

Philadelphia is also rich in historical buildings. The old Swedes church on Swanson street was dedicated in 1700. Christ church on Second street was the place of worship attended by Washington and Franklin. Carpenter's Hall, back of Chestnut street, is the building where the first Congress met. The old State House or Independence Hall was the scene of nearly all the important civil events of the war of the Revolution. Penn's house, formerly on Letitia street, is now in Fairmount Park.

The public schools of the city embrace every grade of instruction from the kindergarten to the high school.

There is a Normal school for girls, a school of manual training for boys, and special institutions for the instruction of deaf mutes and blind. About 2,200 teachers are employed in the various public schools, and the latter are supported at a cost of $1,500,000.

Reading, the county seat of Berks County, is one of the oldest cities in the State, having been founded by the sons of William Penn. During its early history it received a large number of German people, and their descendents form the greater part of the present population. Throughout Berks, Lancaster, and parts of Bucks, Montgomery, Lebanon, Dauphin and York Counties a dialect of the German language, and many of the old-country customs still obtain. The region surrounding is noted for its beautiful scenery, its fertility and its wealth of iron ore. There are more than 400 manufacturing establishments, and the yearly value of their out-put is upwards of $20,000,000.

Harrisburg, the county seat of Dauphin County, is the capital of the State. Several lines of railway center in the city, and there are many extensive manufacturing establishments, including rolling-mills, steel works and car-shops. The city is built on the east bank of Susquehanna River and is situated in a fertile agricultural region.

Lebanon, about twenty miles distant, is near the Cornwall iron mines.

Lancaster, the county seat of Lancaster County, is situated in the heart of the finest agricultural region of the State. It is surrounded by some of the largest tobacco farms in the Union, and the handling and

marketing of tobacco is an important industry of the city. There are also large cotton-manufacturing establishments. Lancaster is one of the oldest cities and at one time was one of the largest inland cities in the United States. From 1799 to 1812, it was the capital of the State. Continental Congress also met in session here after the battle of the Brandywine. Ex-President Buchanan and Thaddeus Stevens are both buried here. The first established State Normal school was founded at Millersville.

York, a borough, and the county seat of York County is the centre of a rich agricultural district from which several railways radiate. Like Lancaster it is noted as being the place where Continental Congress met while Philadelphia was held by the British. The town supports several large establishments for the manufacture of farming tools.

Chester, the largest town in Delaware County, is the oldest settlement in the State. Some of the largest iron ships made in the United States were built at the John Roach ship-yards in this city. There are also manufactures of cotton and woolen goods.

Norristown, the county seat of Montgomery County, is one of the finest residential cities in the State. Among its industries are iron-works, glass-furnaces, and cotton and woolen mills. It is one of the oldest towns in the State, being founded in 1748.

Pottstown, in the same county, contains extensive iron-reducing establishments.

West Chester, the county seat of Chester County, is noted for its beautiful situation and fine residences.

It is the seat of the West Chester Normal School and other educational institutions, and has long been famous for its schools and the culture of its citizens.

Phœnixville, a busy manufacturing town in the same county, contains extensive iron works.

Carlisle, the county seat of Cumberland County, contains a large Indian school. It is also the seat of Dickinson College.

Gettysburg is noted for its mineral springs. It is the site of a historic battle-field of the civil war.

Allentown, the county seat of Lehigh County, is a receiving depot for the coal and iron ore which is to be sent to New York. Several lines of railway and the Lehigh Valley canal pass through the city. The principal industries are connected with the smelting of iron, and the handling of iron and coal. Muhlenberg College and Allentown Female College are situated here.

Bethlehem and South Bethlehem are the centre of a settlement established by the Moravians in 1741. The former is a borough of Northampton County. South Bethlehem is noted for the iron and steel works in which heavy ordnance for the United States war and navy departments is to be made. One of the largest zinc-reducing establishments in the country is located here. It is the seat of Lehigh University, a well endowed and successful institution.

Easton, the county seat of Northampton County, is situated in the heart of a rich agricultural region. Several bridges across the Delaware River connect the city with Phillipsburg, N. J. Easton was the scene of several treaties between the English and the Six Nations. Lafayette College, one of the best known institutions in

the Eastern States, is located here. The schools of the city rank among the best in the State.

Allentown, Bethlehem, and Easton are the principal centres of industry in the Lehigh Valley. Aside from the extent of their coal, iron and other mineral wealth, they are situated in a rich agricultural region.

The Mountain Belt.

Scranton, the county seat of Lackawanna County, is in the heart of the upper, or Wyoming anthracite coal-basin. Seven railways pass through or else terminate in the city. There are several rolling mills for the manufacture of steel rails, which are among the largest establishments of the kind in the United States. The electric street railways which radiate from the central part of the city are the most extensive of the kind in the world. Scranton was founded in 1840, and is the youngest and one of the most progressive towns in the State. It is noted for its excellent public schools. A State institute for educating the deaf by lip-reading is about to be established here.

Towanda, the county seat of Bradford County, is a handsome borough on North Branch. It is in the centre of a productive farming region, and contains manufactures of furniture and farming tools.

Wilkesbarre, the county seat of Luzerne County, is one of the oldest settlements of the State. It is situated in the Wyoming Valley, a beautiful spot made famous by Longfellow. It is in the heart of a rich coal region and is the centre of several lines of railway.

Pittston, Ashley, Plymouth and Nanticoke, also in the upper coal-basin, are the centres of extensive mining operations.

Pottsville, the county seat of Schuylkill County, is in the heart of the southern coal-basin. The celebrated sixty-foot vein is near the city.

Mauch Chunk, the county seat of Carbon County, is an important market for the shipment of coal. It is noted for its beautiful scenery and is called the Switzerland of America.

Tamaqua is also an important coal mining center.

Mahanoy City, Shenandoah, Hazelton and Shamokin are important mining centres of the middle basin. The out-put of the collieries in this belt is upwards of 5,000,000 tons annually.

Williamsport, the county seat of Lycoming County, is the principal lumber market in the State. Several railways and a canal form a commercial outlet for the industries of the town. The manufacturing establishments include about thirty saw-mills. The Susquehanna log-boom for holding the lumber floated down the river, cost upwards of $1,000,000.

Lock Haven, the county seat of Clinton County is also a large lumber-market.

Altoona, Blair County, is at the foot of the eastern slope of the Alleghany mountains. Its importance is mainly due to the extensive car-shops of the Pennsylvania Railway.

Johnstown, Cambria County, is the central of a number of towns whose industries are connected with iron mining and smelting. The rolling-mill at this place employs 7,000 men, and is the largest in the world. It is noted for the great disaster of 1889, caused by a great

storm and the breaking of a dam of a reservoir in the mountains, by which the city was almost destroyed and 2,000 lives were lost.

The Western Plateau.

Pittsburgh and Allegheny City form the commercial and manufacturing metropolis of the western part of the State. The two cities are on opposite sides of the Ohio River, but practically form a single business centre with common interests.

The two cities are situated in the heart of the bituminous coal and iron fields and are surrounded by a productive agricultural region. To these natural resources natural gas has recently been added, thus giving them advantages possessed by no other cities in the east. A locomotive every two days, a steel rail every minute, and a lamp-chimney every second are among the products of manufacture. About forty rolling-mills, twenty steel-mills, and 8,000 coke-ovens are also witnesses to the enterprises of Western Pennsylvania. One-fifth of the iron manufactured in the country is made in and near Pittsburgh.

The amount of freight handled at Pittsburgh and Allegheny is exceeded in but few cities. Aside from the vast amount of railway traffic, more than three thousand steamboats and barges are required to transport the freight that goes down the Ohio River. With the improvements recently made in the navigation of this river and system of towing in barges, freight has been profitably transported at a rate of five cents per ton for every hundred miles.

Both cities are well provided with schools for common and higher education. The Western University of Pennsylvania and Pittsburgh Female College are located at Pittsburgh; Allegheny Observatory at Allegheny City.

McKeesport, a borough of Allegheny County, is an important depot for the shipment of coal and iron. It contains iron and steel works, and its industries are identical with those of Pittsburgh.

Titusville, Crawford County, is the principal city in the oil region. It is the seat of numerous oil-refineries, and the various industries connected with oil-production.

Meadville, in the same county, is in the centre of rich oil-fields, and is the seat of Allegheny College.

Bradford, McKean County, is lighted and heated by natural gas. Its interests are connected with the production and shipment of oil. FRANKLIN and OIL CITY, Venango County, WARREN, Warren County, and CORRY, Erie County, are all centres of the same industry.

Erie, the county seat of Erie County, is the only important lake-port in Pennsylvania. The city is situated on a bluff overlooking Presque Isle Bay. The bay, which is formed by the long curved spit known as Presque Isle, is the finest natural harbor on the Great Lakes. There are extensive manufacturing establishments in the city, among which is one of the largest boiler-making shops in the country. There are also extensive car-building shops, and manufactures of iron, brass, and wood-ware. The schools of the city are noted

for their excellence. In the harbor of this city Commodore Perry built the fleet with which he achieved his famous victory.

NOTES.

Philadelphia makes more carpets than any other city in the world.

The supply of natural gas in Pittsburgh has so decreased that the consumption of coal is again becoming general.

PART II.

PHYSICAL GEOGRAPHY.

The surface of Pennsylvania is not a level plain like that of the Mississippi Valley. Mountain-ranges traverse the State north-east to south-west. Rivers have worn deep channels in the rock, and everywhere there is a succession of hills and valleys, forests and fields, rivers and cañons.

The hand of man has been busy boring into the mountain-sides to get the enormous wealth of coal and iron; building cities and towns where are manufactured an endless variety of articles demanded by civilization; building railways, cars and locomotives to carry these articles to every part of our country; and building ships of iron and steel to carry the products of industry to other and distant lands. We shall scarcely find another State in which nature has done so much for man, and where man has done so much for himself.

Let us study some of the natural features of the State, —the mountains, the rivers, the valleys and cañons, the coal and the iron mines. We shall find that they have done much to shape and develop man's work, and to these is owed almost everything that has made Pennsylvania one of the richest parts of the world.

Mountains.

Mountain-ranges are immense folds or wrinkles in the earth's crust. Sometimes there is only a single wrinkle,

but oftener many such folds are ranged side by side. Usually the various folds are nearly parallel, forming a belt that extends many miles in length.

Sometimes, however, instead of a series of long, regular folds, there is an irregular cluster or group of highlands in which short ridges have been thrust together almost as one would crumple paper with the hand. The Alps, the Adirondack and the White Mountains are good examples of this kind of formation.

The single fold of the earth's crust is commonly called a *mountain-range*, and the various ranges which compose a great mass form a *mountain-system*. The top of a ridge or range is its *crest*. A part of the crest which rises above the average height is called a *peak*. Isolated mountain peaks rising from a level plain are of very rare occurrence, and are always volcanic in origin.

It is now generally thought that mountains were formed by the shrinking of the earth's crust over a cooling interior. As the interior of the earth parted with its heat, it contracted or became smaller in bulk. As a result the outer parts, in shrinking over the contracting mass became wrinkled and crimpled, just in fact as the skin of an apple shrivels and folds when the pulp contracts, because of its loss of bulk.

It has required many ages for the formation of mountain folds, and it is more than likely that the crumpling process is still going on in even the oldest mountain-systems. We can best understand how slowly the process of mountain-formation has gone on when we learn how the Delaware, Lehigh, Schuylkill, Susquehanna and Swatara Rivers have cut their channels through the Blue Mountains.

These streams flowed in much the same place they do now long before the Appalachian highlands existed. When the uplift of the mountain-fold began, it progressed so slowly that the river cut away the rock just as rapidly as it was raised above the level of the river bed. Finally when the mountain-folds had been completed, the rivers flowed in deep, self-worn cañons—the water-gaps of the present age.

All during the time when the mountain-folds were rising above the surrounding level, the elements were at work wearing away their crests and sides. Frost and ice were at work splitting off the surface of the mountains, and running water carried the silt to the plains below, and then to the sea. Thus while one force was uplifting mountain-chains, another was at work wearing them away.

Some of the ranges of the Appalachian system would have been at least eight or ten miles high, had it not been for their rapid wearing away under the erasive action of ice and running water. So that what now remains of these gigantic folds are only a few weather-worn ridges averaging scarcely half a mile in height.

Rivers.

The water which falls on the land as rain and snow would, if evenly distributed, cover its surface with a depth of more than three feet yearly. Some of this sinks into the ground to reappear as springs; some is carried off in the form of vapor; and some gathering into channels flows back to the ocean, whence it came.

The beginnings of most streams are high on the high mountain-slopes where the rain-fall is heaviest and

where snow lies on the ground perhaps all the year round. Here, too, springs are most numerous, and here the uneven surface forms so many of the natural channels into which the water may collect.

Let loose from some winter's drift of snow, or trickling from a spring, the water collects in rills and rivulets and tumbles down the mountain side through pebbled gullies, or plunges over steep clifts in silver-streaked cascades, cutting its way deep into the hardest rock, or tossing aside obstacles that can be moved by its flood.

When it reaches the lowlands its behavior is wholly changed. It then drops all but the highest sediment or silt and flows with a quieter current. Other mountain torrents have swelled its volume, and their combined flood pours onward to the sea.

During times of drought the river flows usually with a clear current, but with the breaking up of winter and during seasons of excessive rains, the water is filled with silt. Double the velocity of the current and the river will carry sixty-four times as much silt; decrease the velocity and the water will drop silt in like proportion.

In this manner the river brings down a vast amount of pulverized rock from the mountain-slopes. Here its current is so swift that it scours off the flanks of the mountains rapidly. All these scourings are spread out over the lowlands, and in this way the deep cañon between mountain-ranges is filled up, making a fertile valley.

In this valley as the slope decreases little by little, the current becomes slower and slower. Because it becomes slower the water must drop some of its silt, and because it cannot carry the silt it must thereafter flow around it.

It therefore spreads out in sinuous loops and sweeping curves.

This goes on until the river has built its banks and bed higher than the surrounding land. By and by, during a season of floods the velocity of the current is increased. Then the river breaks through its banks and makes its channel in a new place and on lower land.

In this way the valley is filled up and leveled off. During past ages, the Mississippi River must have flowed in all parts of the lower valley which bears its name, building its bed and banks higher than the land on either side, and then cutting through them. All along the valleys of the Schuylkill, Susquehanna and Delaware Rivers, except when they flow through the water-gaps, one may every where see how step by step the process of valley-making has been carried on.

When the river reaches the ocean it flows either through a delta that has been pushed out far into the sea; or else it flows into a V-shaped estuary that extends many miles into the land. Evidently these conditions are exact opposites. Let us see how these wide extremes are caused.

Rivers like the Mississippi, the Po, and the Nile all flow into seas in which there is but a slight rise and fall of the tide. So when their waters reach the sea the current is checked and all the remaining silt is dropped. There being no strong tidal currents to carry it away, it is spread out little by little until it covers an area extending a hundred miles or more into the sea.

On the other hand rivers like the Delaware and Susquehanna reach a coast that faces unusually strong tide-waves. The tide rushes up their lower, V-shaped

channels in strong, vigorous waves whose current back and forth is greater than that of the river itself. As a result, an estuary is formed, which, constantly flushed by the strong current of the tide-waves, grows wider and deeper.

There is another feature of rivers so general that it may properly be called one of the laws of river-hydrography. We naturally assume that a river lengthens its course either by increasing the number and the amplitude of its loops; or, if it flows into the sea at some point which does not face the tide-waves, by extending its delta into the ocean. These assumptions are true; we may notice the operations of the first law in all rivers which flow through alluvial plains; and of the second in such rivers as the Nile, Mississippi, Ganges, Po, and Rhone. The Po, for instance, in the last thousand years, has extended its delta seaward for more than twenty miles, and the Mississippi, in very recent geological times, has built its delta fifty miles or more into the present area of the Gulf of Mexico.—But it is seldom we consider the fact that, while a river is building its bed and banks out into the sea, it is excavating its sources backwards in order to get the material wherewith to extend its delta.

The recession of the sources of a river is a feature nowhere better illustrated than in Pennsylvania. The various streams which form the head-waters of the Susquehanna and the Schuylkill are rapidly cutting their sources backwards, and the area of their basins is constantly changing. The changes of area are slight for each successive year, it is true, but they need only the factor of time to make them great. A stream of

water flowing on the slope of a low ridge, in the course of years carves its channel across the ridge. It then taps the waters of the stream flowing on the opposite side of the ridge and finally absorbs them. The stream on the opposite side may have crossed the ridge at some point lower down, but its waters having been absorbed by the more rapidly corroding stream, a dry bed is left to mark its former course. It is in this manner that the curious 'wind-gaps' have been made, but from the foregoing description it will be seen that the wind-gaps are nothing but older water-gaps.

Prof. W. M. Davis has described one case of this which possesses more than ordinary interest. The channels, Deer Run and Perkiomen Creek, are on opposite sides of a divide. At its sources the former has a fall of about sixty feet to the mile, while the latter flows upon a slope hardly more than one-half as steep. As a result the channel of Deer Run has carved its way backwards, and has robbed Perkiomen Creek of three or four of the tributaries formerly flowing into the latter. In the maps of the region involved (Montgomery, Lehigh and Bucks Counties), perhaps the most noticeable thing about the drainage basin of Deer Run, is the back-hand manner in which its upper tributaries flow into the main stream.

Lakes.

Lakes are the most ephemeral features that diversify the land. The stream that flows into a lake is constantly filling up its bed with sediment; the river that flows out of it is all the time cutting away the rim of its basin and thereby draining off its waters.

Lakes are bodies of water in depressions of the earth's surface. The hollow or depression is called the lake-basin. The divide or ridge which forms the highest part of the lake-basin is called its rim. Within the rim the land on all sides slopes towards the lake.

There are many depressions in the surface of the land in which there are no lakes. If more water collects in the basin than evaporates from it, a lake or pond will result. If, however, the water evaporates as fast as it collects, no permanent lake can be formed.

As the water gathers in the basin, its level rises higher and higher until, at length, it flows over the lowest edge of the rim, or else it reaches a level where just as much water evaporates as flows into the basin. In the former case the waters of the lake always remain fresh and sweet; in the latter they are apt to become salt. Let us see why.

When running water flows over soil and rocks that contain salt or other soluble minerals, the water dissolves part of it and carries it to the lake. If the latter has an outlet both the water and the salt flow out. If on the contrary the lake has no outlet the water evaporates while salt accumulates in the basin, until by and by the water is a strong brine.

There are many lakes, however, whose waters remain fresh, even though the lakes have no outlet. The reason is that the soil over which their inlets flow contains no soluble mineral matter that the water can reach. There are many thousand such lakes in the northern part of the United States and Canada.

There are many ways in which lake basins have been formed. In some instances they were formed when the

upheaval of land-masses took place; some have been made by sand-bars, which, forming across a narrow bay have shut off a part of the sea.

But most of the small lake basins are thought to have been scoured out by the immense sheets of glacial ice which once covered much of the northern hemisphere. It is thought that most of the lakes of Pennsylvania were formed in this manner.

Look at any good map of the Dominion of Canada, and the great multitude of small lakes is the most noticeable feature on the map. Notice too that most of them are grouped in chains and that a river flows through each chain. All these lake basins received their final shaping from the ice-sheet that once covered the northern part of the American continent.

Glaciers.

Glaciers are streams or sheets of ice moving slowly down a ravine or a sloping surface. They are not improperly called rivers of ice.

The snow that falls upon the flanks and crests of mountain-heights is removed in various ways. Much of it melts under the summer's heat; a small amount evaporates; but a large part tumbles down the sharp slopes in the form of avalanches, or else is gathered into ravines by the fierce blasts of winds that whistle among the crags and peaks.

Let us ascend the mountain-side until we reach the head of one of these ravines. Here an abundance of snow has gathered, and it is almost as light and fleecy as when it fell. A little way down, the flaky snow gives place to the granular snow which we always see at the breaking up of winter.

This granular snow, or *nèvè*, is composed of minute rounded grains of ice. A little farther down and the snow disappears. It has been compacted by pressure into ice—just, in fact, as we make balls of fine, light snow and squeeze them between the hands until they are balls of solid ice. At first the ice is white and full of air bubbles, but soon the enormous pressure squeezes the air out, and the ice then becomes deep blue in color.

Examine this body of ice and we shall find it is in motion. Its flow is very slow—not more than twenty or thirty inches a day, but otherwise its current is much like that of a river—most rapid in the middle of the channel and slowest at the sides. At first the ice is tolerably smooth, but further down the ravine it is seamed with cracks which extend across its surface.

The position of these cracks, or *crevasses*, is always changing by the constant pressure of the ice. A crevasse will form, and then its gaping sides close and are welded or frozen together, and another *crevasse* is made elsewhere.

All along the sides of the glacier rocks and earth are falling down the slope and lodge on the edge of the ice. These in time form long walls which are called moraines. By and by as the ice is pushed far down into the region of cultivated fields the ice give place to a torrent of muddy water—the beginning of a river.

The lower end of the glacier often pushes a wall of rock in front of it, called the terminal *moraine*. During the summer season the end of the glacier recedes some distance, but in the winter it again advances downward, each time pushing ahead its terminal *moraine*.

This in time becomes a wall of rock, sometimes a hundred feet in height.

But the glaciers which flow in the ravines of the Alps, as well as those of Mts. Shasta, Tacoma, and the Alaskan Range are small and insignificant compared with those which are found on the western coast of Greenland. Here the glaciers are a vast sheet of ice covering often several thousand square miles. One of them, Humboldt Glacier, has a sea-front sixty-miles in length, and the fragments broken from it become the icebergs so dangerous to vessels plying between New York and Liverpool.

It was glaciers of this sort that formerly covered the northern part of North America. They scoured out the multitude of lake basins in the United States and Canada, and strewed the surface with boulders. Many of these boulders are found scattered over the north-eastern and north-western parts of Pennsylvania.

The terminal moraine of this immense glacier is still plainly marked, and the long ridges of boulders pushed in front of the ice, are still visible—mute witnesses to the long glacier period. In Northampton, Monroe and Susquehanna Counties this is in places more than sixty feet in depth, and in all parts of the State north of the moraine the ground is strewn with boulders that the ice brought from regions lying to the northward.

It is not necessary to look abroad or to distant parts of the western highlands in order to study glaciers. One may frequently see miniature glaciers in ravines and cañons of Pennsylvania, at the breaking up of winter. Even the sheets of snow that slip little by little from the roofs of houses, during the thaw that follows a heavy

snow storm, frequently show nearly all the phenomena that may be seen in the study of the largest glaciers.

The Weather Bureau.

The Weather Bureau, under the control of the War Department, is a department established for the purpose of the publication of such forecasts of the weather, as will be of service to agriculture and commerce. The forecasts include:—

The approach of storms.
The probabilities of frost.
The direction and probable changes of the wind.
Probable changes of temperature.
Threatened floods in rivers.
High or destructive winds along the coast.

In order to ascertain the information necessary to make these forecasts, about 300 stations have been established in various parts of the United States. At each station thrice a day at the same moment observations are made of the temperature, height of the barometer, amount of moisture in the air, and general condition of the weather. The results of these observations are telegraphed to the central office at Washington and entered upon a map of the United States.

It is then seen at a glance whether or not there are any areas in which the barometer is unusually low, or any in which the barometer is higher than normal. The area of low barometer is called a 'storm,' and it has been found that the wind from all directions is blowing towards it.

As the wind approaches the centre of this area, its direction is somewhat changed, so that near the storm-

centre it has a whirling motion. Usually a storm is attended by more or less rain, but this is not always the case,—there may be nothing more than high winds. The rain does not always fall in all parts of the area of low barometer, but more commonly only in front of it.

Many years of observation have shown that all storms in addition to their rotatory motion in the northern hemisphere move from a point in the west or south-west to one in the east or north-east. With this knowledge it is not difficult to predict the approach of a storm.

With each day's reports it is readily seen whether a storm or area of low barometer has formed anywhere in the west. The storm once formed, its direction and the velocity of its advance may be predicted with tolerable accuracy. In fact they are practically known before hand, and it is only when the storm swerves from its ordinary track that the prediction concerning it fails.

There are two storm-tracks east of the Rocky Mountains which nearly all the storms follow. Those forming at the eastern base of the Rocky Mountains advance eastwardly by a little north. Those forming in the Caribbean Sea or the Gulf of Mexico move in a north-easterly path, sweeping along the Atlantic Plain, but rarely extending west of the Appalachian Mountains.

The approach of a storm may often be foretold by an inspection of the wind and clouds. Let us suppose a storm has formed at some point in the west, and that its path lies across the State. A moment's thought will show us that such a storm will be preceded by an easterly, and will clear with a westerly wind. In most cases, especially in winter, the storm is preceded by

warmer weather and followed by a cold wave—that is a fall in temperature to below 40° F.

A system of signal flags has been adopted by the United States and by most of the State Weather Bureaus. Fair or clear weather is indicated by a white flag; rain or snow by a dark blue flag. Temperature is indicated by a triangular flag above or below the weather flag. If no change of temperature is anticipated no temperature flag is displayed. If the triangular flag is above the other, *warmer* weather is indicated; if below, *colder* weather will follow. A probable cold wave is indicated by a white flag with a black square in the centre.

COAL.

Coal is a mineral consisting mainly of carbon, which occurs in nature and the arts in the various forms of mineral coal, charcoal, lampblack, diamond, and graphite or plumbago. It is also the chief element in animal and vegetable tissue, in mineral oil or petroleum and in natural gas.

Although coal is classed among minerals it is undoubtedly of vegetable origin. As we look at the shining, black lumps that we throw upon the grate or into the furnace, there is nothing to connect them with the delicate forms that we see in the beautiful leaves and flowers, twigs and shrubs, with which nature has bedecked the landscape.

Let us take a piece of coal, however, and split it into thin layers. As we cleave the layers one after another we shall here and there find the imprints of leaves, their outlines just as perfect as they were the day they fell from the stems in which they grew many thousand years ago. Or, perhaps, if we grind a small, flat piece

so thin that it is transparent, we shall be able to see the fibres and cells of plant-growth.

No matter where we get coal—from England, China, Pennsylvania, or California—we can scarcely find a piece that does not bear witness to its vegetable origin. Sometimes we find stems of peat-moss, sometimes ferns, sometimes large tree-trunks. Even in the hard, glassy anthracite coal traces of vegetation may be occasionally found.

Although coal is of vegetable origin it is classed among the minerals. In position and arrangement the testimony of their having been formed by the action of water is so strong, that the coal-beds are classed among the water-formed or stratified rocks.

Let us see how all this vegetable matter accumulated so as to form the coal-beds. In some instances we find the coal to consist almost wholly of peat-moss, and it is thought that what now constitute such beds of coal were formerly peat-swamps—just such swamps as we find to-day. If we examine almost any swamp we shall find the half-decomposed vegetable matter covering the swamp to a depth of many feet. Because the swamp does not dry up, dead stalks and leaves cannot be removed. To a certain extent the water preserves them, and the amount of vegetable matter thus constantly increases.

The substance called 'peat' may be the remains of almost any creeping plant that grows under water, but it is generally used as the name of a kind of moss that grows in the form of a long slender stem, without roots, leaves or flowers. Although it dies at one end of the creeper, it retains life and carries on a vigorous growth at the other.

Such swamps are common in all parts of the world, and in many countries the fresh peat washed and dried is almost the only fuel used. Peat swamps are common in Ireland, in France, and along the Danube. In the United States they are so common that there is scarcely a State east of the Rocky Mountains where they are not numerous. It is not uncommon to find these quaking bogs underlying many square miles, and having a depth of sixty feet or more.

In other instances the coal bed was formerly an immense mass of drift wood, which was carried down by rivers and lodged somewhere along their lower courses. The formation of such drifts in rivers was very common in former ages; it is common even at the present time. There is such a drift in the Red River, covering an extent of many square miles; there are several in one of the branches of the Columbia River that are very large. Furthermore these drifts, or rafts as they are called, are constantly increasing, because while floating matter is always lodging at the up-stream end little or none floats away from the lower part.

In the gold-mines of California several such rafts have been found at different depths underground. In a certain instance one raft lies above another with about one hundred feet of gravel between them. The timber of the lower drift lay in water, and has been partly changed to coal. The upper raft was left in a dry place and the timber, although nearly 400 feet under ground, is perfectly preserved.

The next step in the formation of the coal was the covering of the peat-bog or timber-raft with sediment which was swept over it by waves, by floods or by the

current of the river. As year after year passed the accumulation of sediment, gravel and coarse drift kept on growing in thickness until the layer of vegetable matter was many feet under the surface.

The enormous weight of the sediment soon pressed the layer of peat together until it was perhaps less than one-tenth its former thickness. The pressure generated heat, and the natural decay of the vegetation added still more. Little by little in the long lapse of time the woody tissue changed under the combined action of heat, pressure and moisture until finally it acquired the form which we now call 'coal.'

At first it was much like the *brown coal* or *lignite* that is found in parts of California. It was rather more like coal than wood, but still preserved much of the appearance it had when in its natural state.

As the process of formation continued the brown coal was gradually converted into the *bituminous* or *soft coal,* such as is found in western Pennsylvania, and the Mississippi Valley. Bituminous coal breaks into blocks often of very regular shape. In nearly every case it splits easily into thin parallel layers. Moreover when thrown upon the fire it partly melts into a thick tarry mass known as *asphaltum* or *bitumen.* Bituminous coal is rich in many useful products. The tar or bitumen is easily driven off by heat. It yields illuminating gas, paraffine, carbolic acid, vaseline, and the beautiful aniline dyes. It also yields the valuable medicines antipyrene, salol and sulphonal. Some varieties like *cannel* (or *candle*) *coal* consist almost wholly of bitumen.

But there is still another kind of coal that occurs in a few small areas in the Appalachian Mountains, as *stone*

or *anthracite coal.* It is much harder than the other kinds of coal, and has a bright glossy appearance when freshly broken. This sort of coal burns with but little flame and smoke, and does not yield any coal tar or gas when it is heated.

The reason for this is not hard to find. When these coal-beds were young, the seams lay flat, and the coal did not differ from other soft coal. But, in time, when this vast expanse of land was crimpled and wrinkled into the folds we now call the Appalachian Mountains, the coal-seams were so squeezed that between the heat and the enormous pressure, all the volatile matters were driven off. In fact anthracite coal does not differ greatly from the coke that is made in the retorts at the gas works, and if we could take the hot coke from the retorts and subject it to great pressure it would not differ from anthracite coal.

In some cases the combined action of heat and pressure was carried on to such an extent that the vegetable matter was finally changed to the mineral called *graphite* or *plumbago,* but which is best known as *black-lead.* This mineral does not burn at all. On the contrary, it is often used in making crucibles which are to stand intense heat. Some varieties of anthracite coal, especially that mined in Rhode Island, resembles graphite in luster, and is so hard that it burns with no little difficulty.

The making of coal has been going on in nearly all times in the earth's history. We find coal associated with the rocks of nearly every age. The most extensive as well as the thickest beds were formed at a period between the Age of Fishes and the Age of Reptiles. This period is generally known as the Carboniferous or

Coal Age. Many large fields, notably those in the western coast of the United States, were formed at a much later age. These are generally called cretaceous coals.

The same laws which underlay the formation of the coal-fields of past ages are still busily at work. Just as the peat-swamps of a former period are the coal-beds of to-day, so the timber rafts, the peat-bogs and the tule-marshes of to-day will be the coal-fields of a future age —the sun's heat condensed and stored up for use in time to come.

The coal-fields of the United States underlie an aggregate area of nearly 200,000 square miles. Of the various fields the Appalachian is the richest and most productive in the world. It underlies the whole of Western Pennsylvania, Eastern Ohio and parts of West Virginia, Kentucky, Tennessee, Georgia and Alabama. The aggregate thickness of the workable seams is about 120 feet, and its area is not less than 60,000 square miles.

From the foregoing paragraphs it will be apparent that the coal-fields physically considered are nothing more than condensed sunlight and heat,—vast reservoirs of solar energy first developing vegetable growth and thence stored up in times past for our use to-day. Properly applied, the energy contained in a single pound of coal is more than equal to the physical labor of a strong man for a day.

Petroleum.

But little is known about the origin of petroleum. It is found in various parts of the world. There are fields or horizons of unknown extent in Canada, West Virginia, Ohio, and California. It occurs abundantly

in various parts of Europe and Asia, especially along the Caspian Sea. These fields of which Baku is the commercial outlet are the most extensive known.

It is thought that the oil-fields of Pennsylvania are connected with the vast deposits of sea-weed and coral-loid growths that were formed during the early (Paleozoic) history of the earth, but just how the oil was formed and stored up in its present beds is a matter of hypothesis, but little better than guess-work. There is evidence, however, that the oil was formed under great pressure and in the presence of salt water, and at a temperature lower than that of boiling water. This theory, however, will not hold true of the California fields. In the Pennsylvania fields the oil occurs in three strata of sandstone separated by layers of shale, each upwards of two hundred feet thick.

Petroleum is not a true oil, but a mixture of liquid substances, some of which are highly volatile. It is 'refined' by distilling the crude oil at different temperatures. Naphtha and benzine (a mixture of volatile substances) are first driven off, and then the moderately volatile mixture which constitutes the kerosene or coal oil of commerce. The two products are condensed in separate receivers. There remains a sluggish oily substance in the retort from which a good lubricating oil is manufactured. Paraffine, 'cosmoline' or 'vaseline' and asphaltum are among the useful substances obtained from petroleum. Good coal oil when heated in a shallow vessel should not give off an inflammable gas—one which takes fire from a lighted match—at a temperature lower than 150°. This is known as the 'flash test.'

The crude oil is obtained by drilling artesian wells through the overlying strata of rock. When a field is 'new,' *i. e.*, recently tapped, the wells are usually 'spouters,' the oil frequently spouting several feet above the surface. After a time the pressure lessens, and the oil must be pumped to the surface. Occasionally as a well becomes sluggish, a change or 'torpedo' of dynamite is exploded at the bottom of the well. This by shattering the sandstone increases the flow of oil. At present nearly all the wells in the State as well as the refineries are controlled by the Standard Oil Company.

Natural Gas.

Our knowledge of the origin of natural gas is even more theoretical and uncertain than that of mineral oil. Sometimes we find it associated with the latter, but in other localities they exist at wide distances and seem to have no connection. A common theory is that in some places the oil-deposits, in others the coal-beds, have been subjected to a moderate internal heat, and the volatile gases driven off have collected in reservoirs under impervious layers of shale, etc. This theory, although consistent, is but little better than a guess.

The gas is obtained in the same manner as petroleum. An artesian well is sunk until a gas-reservoir is tapped. In new wells the pressure of the gas sometimes exceeds 300 pounds per square inch. Thus far the waste of gas has been enormous, and in many instances it is burned at the mouth of the well in order to get rid of it. Lately attempts have been successfully made to use it in smelting ores, generating steam, and for lighting and heating houses. Its use in Pittsburgh has changed that city from the smokiest to one of the cleanest in the

country. The great decrease in the pressure of the gas in many places is looked on as an indication that the supply is not inexhaustible—an apprehension that has somewhat checked the extravagant waste. About twenty cubic feet of air are required to consume one cubic foot of gas.

IRON.

Iron is rarely found in nature as a metal: nearly always it is combined with some other element such as oxygen, carbon, or sulphur, and the process of 'smelting' consists in freeing the metal from these elements. The most common ore is generally known as *hematite* and is composed of iron and oxygen in the proportion of about three-fifths of the former and two of the latter. The metal is separated from the oxygen by heating it strongly with good coke or charcoal.

The ore is placed in the smelting furnace with alternate layers of coke and limestone, and then a strong blast is applied so as to intensely heat the contents of the furnace. Now charcoal or carbon has a much stronger greed for oxygen than the iron has, and when the ore reaches a white heat, the atoms of carbon begin to catch atoms of oxygen and fly off with them in the form of a gas.

As fast as the oxygen atoms are carried off the iron drops down in a molten state, while the limestone holds the various earthy matters which do not melt. When considerable molten iron has gathered at the bottom of the furnace a plug is drawn and the iron runs out and is collected in short furrows that have been made in the sand to receive it. Fresh layers of ore, coal, and

limestone are thrown into the furnace at the top and so the process goes on day and night.

The metal drawn off is called 'pig' iron. It is by no means pure, and before it can be used must be refined. If it is to be run into castings it is remelted in a 'cupola' furnace with a strong blast so that the greater part of the carbon is consumed. The amount of aeration it receives depends on whether a fine and tough or a coarse and brittle metal is required.

Most of the ore, however, is destined to make *wrought iron*. For this purpose the crude metal is melted in a shallow furnace through which a draught of air is forced. As the carbon and other impurities are burned the molten mass is constantly stirred until it has become tough and pasty. This is called 'puddling' the metal, and the furnace is a 'puddling furnace.' When the metal has become quite stiff the puddler heaps it into balls weighing about one hundred pounds each. These are passed between heavy rollers, reheated and rolled again and again until the iron is formed into bars, rails or plates.

Steel differs from iron in containing a definite, fixed amount of carbon. In the manufacture of Bessemer or crucible steel, cast iron and a certain amount of selected ore are smelted together. A strong blast of air is forced through the mass until all but the necessary percentage of carbon has been consumed. The metal is then cast into huge ingots which are successively heated and rolled until it receives its final shaping.

The value of iron represents the value of labor only. A pound of pig iron is worth, perhaps, a cent; a pound of steel converted by skilled labor into hair-springs for watches is worth several thousand dollars.

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The following list embraces all leading colleges and schools for higher and technical instruction.

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Pennsylvania College of Dentistry	"
College of Physicians and Surgeons	"
College of Pharmacy	"
Hahnneman Medical College	"
Nautical and Engineering College	"
Polytechnic College	"
Women's School of Design	"
Academy of the Fine Arts	"
Girard College (industrial)	"
School of Industrial Art	"
Bryn Mawr College (for women)	Bryn Mawr.
Pittsburgh Female College	Pittsburgh.
Western University of Pennsylvania	"
Allegheny College	Meadville.
Franklin and Marshall College	Lancaster.
Lafayette College	Easton.
Beaver College	Beaver.
Mulhlenberg College	Allentown.
St. Thomas of Villanova	Villanova.
Lehigh University	South Bethlehem.
Ursinus College	Collegeville.
Lincoln University	Lincoln University
Dickinson College	Carlisle.
Pennsylvania State College	Centre County.
Pennsylvania College	Gettysburg.
St. Vincent's College	Latrobe.
Bucknell University	Lewisburg.
Washington and Jefferson College	Washington.
Waynesburg College	Waynesburg.
Westminister College	New Wilmington.
Swarthmore College	Swarthmore.
Haverford College	Haverford.

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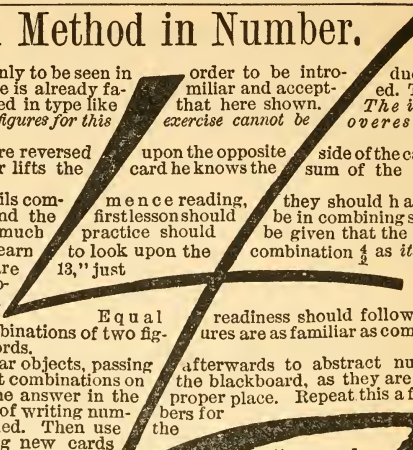

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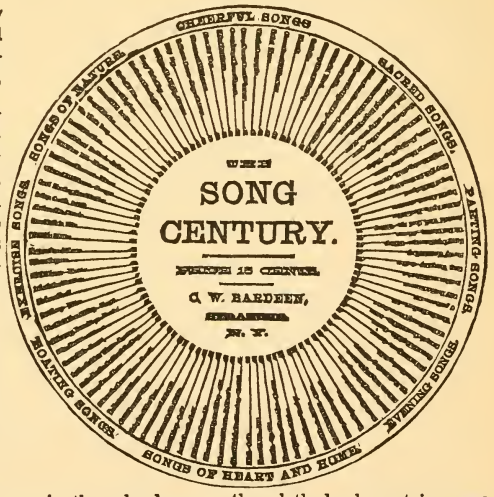
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C. W. BARDEEN, Publisher, Syracuse, N. Y.

The School Bulletin

AND NEW YORK STATE EDUCATIONAL JOURNAL,

Established 1874. 16 *Pages,* 10x12. $1.00 *a Year.*

The SCHOOL BULLETIN is one of the five oldest educational journals in America, and has been under the same editor and proprietor from the beginning. It is not filled with "methods" and other spoon-food for young teachers who want their ideas ready-made, but appeals to superintendents, principals, and assistant-teachers who regard their work as a vocation, and who want to look upon it broadly and comprehensively.

In the feature of educational news it has never had a rival. Its chronicles of what has happened in the schools of New York during the past seventeen years are unmatched in educational literature, and it has taken note of whatever has happened in other States that involved general principles.

The following are among recent expressions of opinion that the BULLETIN and its editor have elicited.

"I get a multitude of educational journals, but I read only three of them. One of them is the SCHOOL BULLETIN."—*Hon.* JOHN HANCOCK, *State Commissioner of Schools, Columbus, Ohio, February 20, 1890.*

"We have a great number of exchanges, but there are only three educational journals that I regularly read through, and one of them is the SCHOOL BULLETIN. When I read one of Mr. Bardeen's editorials I say to myself 'There is a man who knows what he is talking about.'"—GEORGE P. BROWN, *editor of The Public School Journal, February 20, 1890.*

"If the reader wants two spicy and sensible essays by the keenest educational writer of the day, he will find in the above what he wants."—*Intelligence, Chicago.*

"In sending my renewal of subscription to the BULLETIN, I desire to express the great pleasure which I have enjoyed in reading some recent articles from your pen, especially the review of Miss Willard's book, and the description of the recent meeting of the National Association. They both show your remarkable power of analysis and felicity of expression."—*Sup't* JOHN H. CLARK, *Flushing, N. Y. September 6, 1890.*

"Permit me to add a word of commendation and appreciation for the articles which have recently appeared in the BULLETIN over your name. Their worth is all the more noticeable when compared with the trash that appears in so many of our educational papers."—GEORGE G. RYAN, *principal high school, Leavenworth, Kansas, September 15, 1890.*

"Am delighted with your article on 'Homely Teachers.' It is not only bright, but beams with wisdom. It is the wisest of the wise things you have ever written. Please send me a dozen copies of the BULLETIN. I want the Oneonta pupils to stand high when examined under your form."—JAMES M. MILNE, Ph. D., *principal Oneonta Normal, and president of New York State Teachers' Ass'n, October 2, 1890.*

C. W. BARDEEN, Publisher, Syracuse, N. Y.

School Bulletin Teachers' Agency.

Not one desirable place in fifty is filled now-a-days except directly or indirectly through the medium of a Teachers' Agency. Nearly all teachers holding responsible positions are themselves enrolled in some Agency and give to this Agency immediate information of prospective changes. Hence an outside teacher has no chance to learn of vacancies. Before he hears of them they have been filled by candidates notified by the Agency. A progressive teacher could afford the annual fee for enrolment in an Agency for the information alone. He might not care to use it, but it is worth two dollars a year to be sure he has missed no opportunities he would like to know of.

The Best Agencies, however, do not depend on information alone. By repeated successes, by fair dealing and through the influence of the teachers they have placed, they have won the confidence of many school boards and employing principals. There are hundreds of schools that systematically engage all their teachers through an Agency and will not consider applications from any other source.

The Fact is, matters do not go so much by chance as they used to in filling vacancies. Time was when nothing was said or thought of changes till the end of the year, but nowadays teachers and school boards both have their eyes wide open. We happen to know as we write that a man now principal of a $1600 school will before the end of the year be appointed teacher in one of the normal schools. We are pretty well satisfied that a man now getting $1400 will have the $1600 place. If he gets it we have our eye on another man now getting $1100 who will be glad of the $1400 place: in every case because these men are especially fitted for these places and desirous of them. All this in January. Now next June some principal who saves his two dollars by not registering in an Agency will read in the morning newspaper that Principal So-and-so has been appointed to such a chair in such a normal school, and will pack his valise, take the train, and hurry off to Principal So-and-so's present place to apply for his position before anyone else gets there. It will surprise him to learn that the vacancy was provided for six months before—if he does find it out. He has saved his two dollars registration fee but he has lost his time, his car-fare, and whatever chance he stood of the place.

One year we sent Principal Poland to the Jersey City high school at $2500; that left a vacancy at Ilion which we filled by sending Principal Winne at $1600; that left a vacancy at Canastota which we filled by sending Principal Ottaway at $1200; that left a vacancy at Amsterdam Academy, and so on.

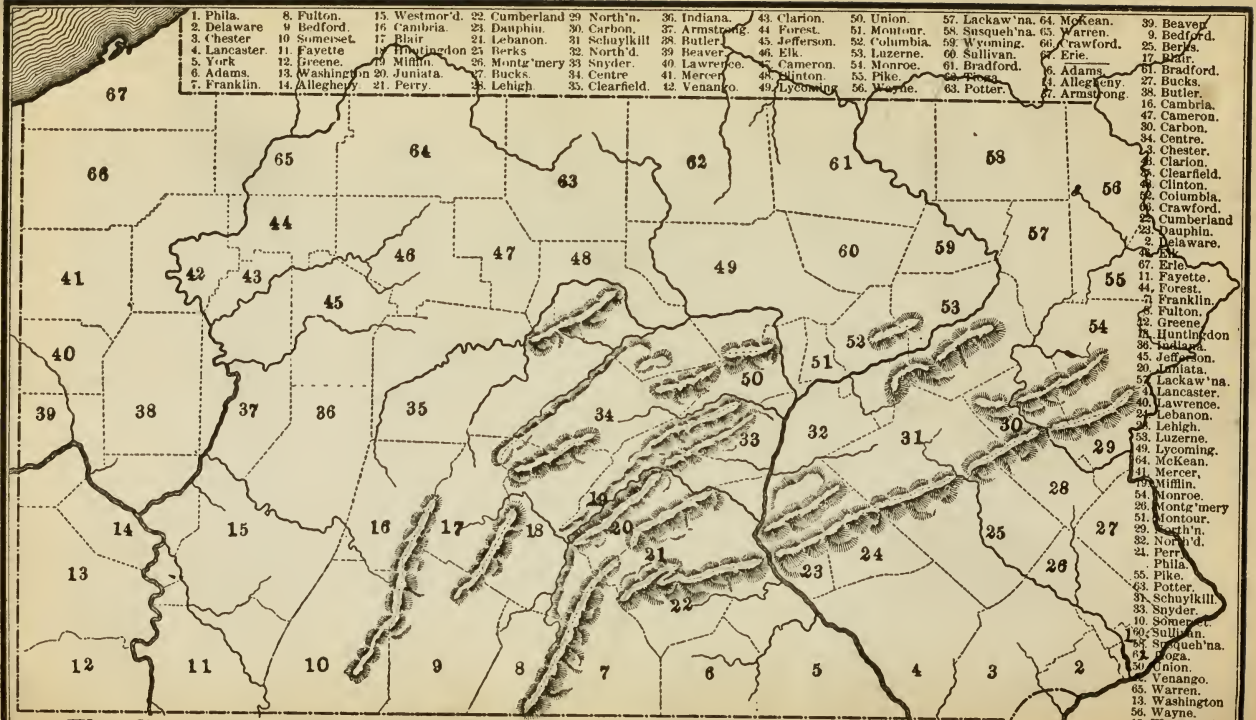
Did you ever see people stand in line at the post-office waiting for their mail? As each one is supplied he goes away, giving place to the next, and so there is a continual moving-up; the man who keeps his place in the line will eventually get to the head. In no profession is there so frequent and so rapid moving-up as in teaching. To get to the top, do your work well where you are *and keep registered.* Presently you will be the man that fits and will be elected, and if you do fit when you get there the Agency will keep its eye on you for the next fit. Try it.

It is Important, however, not only to register, but to register in the Agency most likely to help you. Without reflection upon others it may be said with confidence that the School Bulletin Agency is safe and trustworthy. Aaron Gove, superintendent of schools in Denver, Colo., and late president of the National Teachers' Association, said in the *Colorado School Journal* for July, 1890:

"The *School Bulletin*, edited, owned, and conducted by C. W. Bardeen, at Syracuse, N. Y., is an old and reliable school journal. Its proprietor is a school man and understands his business.....He is also at the head of an educational bureau.....*As at present advised, we are suspicious of bureaus unless we know the man at the head.*"

"The man at the head" of the School Bulletin Agency makes personal selection of every teacher recommended. Send for circulars.

C. W. BARDEEN, Proprietor, Syracuse, N. Y.



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